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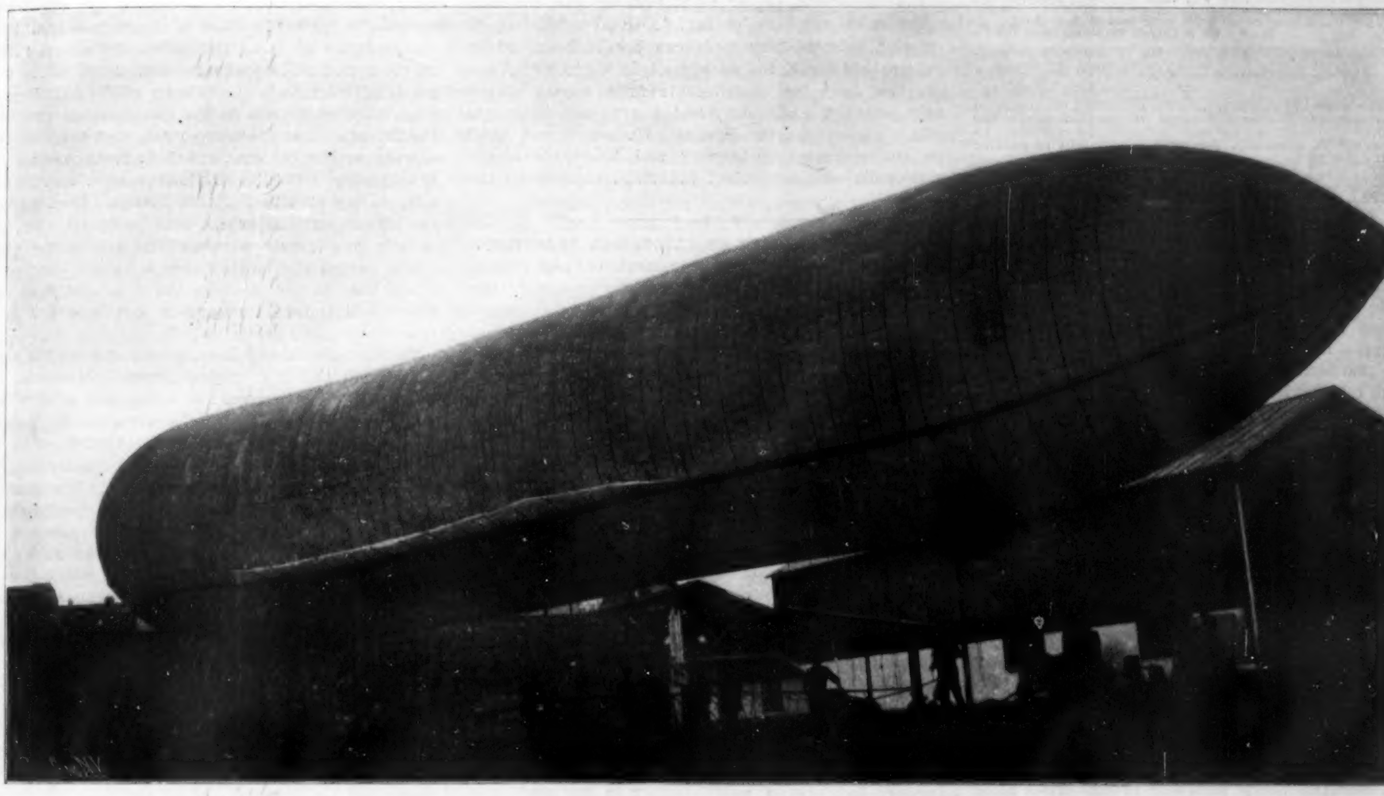
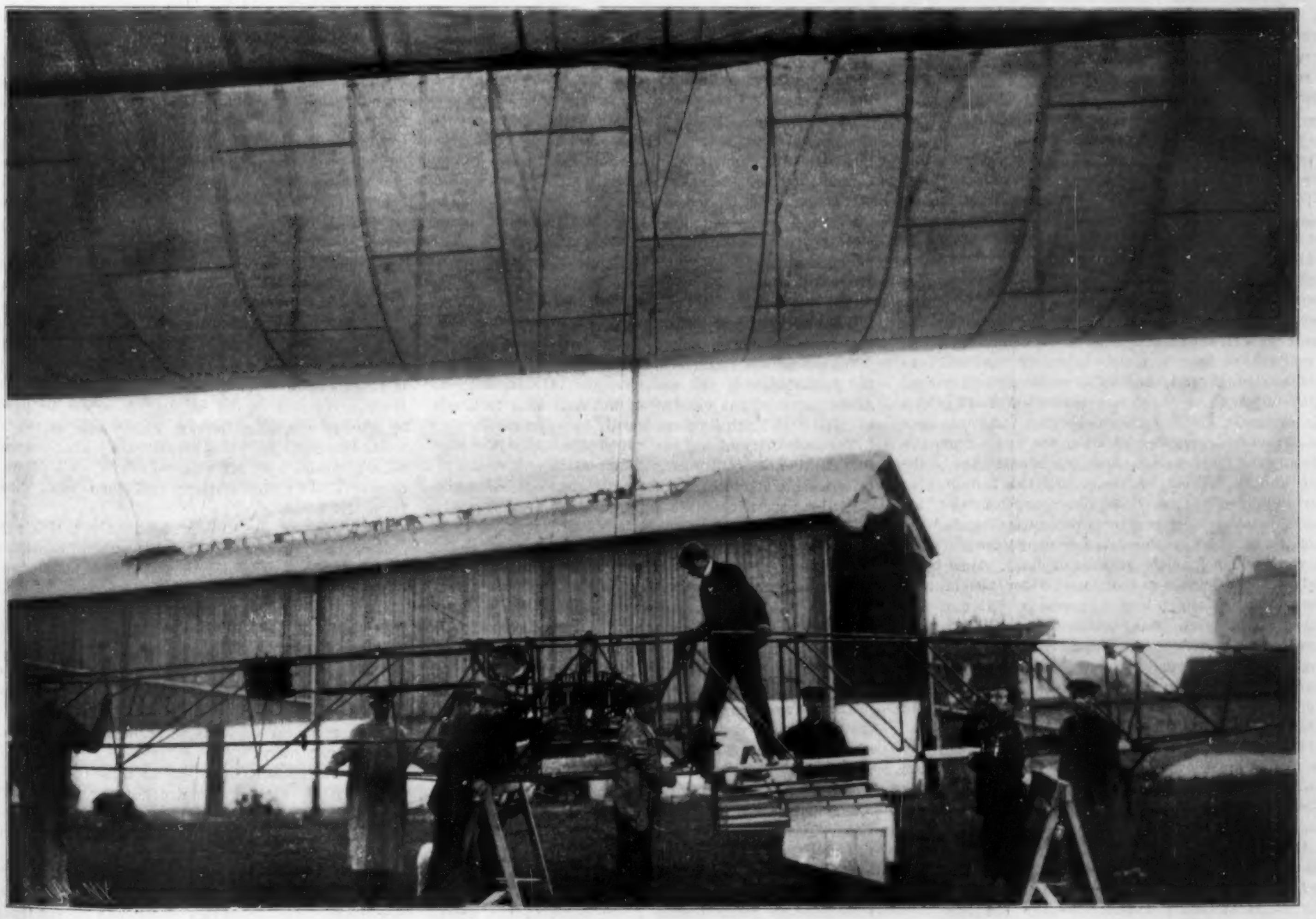


A Picture of De Bradsky's Airship Taken Immediately Before Its Last Flight.



De Bradsky Standing in the Frame of His Airship, Two Days Before the Accident.

THE DE BRADSKY AERONAUTICAL DISASTER.—[See page 331.]

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NEW YORK, SATURDAY, NOVEMBER 15, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paidfor at regular space rates.

MUNICIPAL ARCHITECTURE AND THE ELEVATED RAILWAY.

The series of articles on the Berlin underground and elevated railway, of which the last is published in the current issue of the SUPPLEMENT, teach a forceful lesson in good taste in engineering work, by which Americans may well profit. Probably in the whole world there is no engineering structure that so admirably harmonizes with its architectural environments as this newly-opened Berlin road. Each section of the line was carefully planned to correspond in style with the particular quarter of the city through which it passed; every precaution was taken to relieve the coldness and rigidity that are necessarily found in every trussed iron structure. Artistically designed masonry piers have been introduced wherever possible; arches and towers have been employed, notably at the Oberbaumbruecke, with a singularly happy effect. Here and there, as at the Schlesisches Thor, a station has been built, the formal charm of which immediately arrests attention.

It must be conceded that the Germans and French have a finer sense of architectural fitness than we. Perhaps not in all Europe, assuredly not in Germany and France, would a Manhattan Elevated Railway, obtrusively hideous, with machine-made stations, built with no pretense to beauty, be allowed to disfigure a beautiful public park and to mar street after street with its commonplace iron pillars and frames. In Europe good taste is never forgotten—or rather the municipal authorities will not allow it to be forgotten. Not how cheaply, but how artistically, can a public work be carried out seems there to be the official criterion.

From its very inception the Berlin road was the object of municipal care. It was stipulated that no station should be a blemish to the city; that the traffic of the streets should be interfered with in no way. As a result of this rigid control, the builders of the road were prevented from resorting to many a structural convenience, which, commendable enough from the engineer's standpoint, would have been an architectural blot on a beautiful city. As an example of this fine municipal vigilance, we have but to cite a single example. The western branch of the Berlin line passes through a series of wide, handsome boulevards in the newest and finest residential portion of the city. Between the driveways of the broad central esplanade, it would have been a most convenient makeshift to build a viaduct, and thus to have saved millions of marks. Such an overhead structure would have ruined that quarter of the city architecturally. The company was, therefore, compelled to lower the grade from the Nollendorfer Platz westward, to run beneath the boulevard, and to conceal its road until the terminus at Charlottenburg was reached. The construction of this subway entailed an enormous outlay. Quicksands were encountered which rendered it necessary to drive piles—a work which involved months of delay. How beneficial to the city this authoritative rigor has been is shown tellingly enough by the present condition of that section of the road. The excavated channel is walled in, roofed with earth resting on steel girders and arches of masonry, and surfaced with graceful walks on which shade trees have been planted.

In a city which is growing more beautiful as its old buildings are torn down and better designed structures erected in their place, the architectural enormity of a Manhattan Elevated Railway becomes all the more glaring. Bad from the very begining, it apparently grows worse as finer structures are erected along its line. And yet American engineers seem slow to profit by the lessons which have been taught. The new East River Bridge, stupendous though it be, can surely not be considered an architectural adornment. Artistically it is distinctly inferior to the old Brooklyn Bridge with its noble masonry piers. Here again Germans have shown us what can be done. The traveler who steams up the Rhine must feel how vastly superior are the handsome bridges that span Europe's most beautiful stream. Time and time again we have commented upon the excellence of the design which characterizes these Rhine bridges. At Düsseldorf and at Worms, structures span the river, which have been executed so as to harmonize architecturally with the towns on either bank. Mediæval towers and battlements have been used wherever the cities themselves were mediæval in character. The harsh discord of an intensely modern structure and a mellowed old town has thereby been avoided.

The architectural fate of New York city is in the hands of the Municipal Art Society, which has undertaken to correct, so far as it possibly can, the mistakes made two decades ago. A total rebuilding of existing elevated structures can hardly be asked in reason; but surely the Society might see to it that the overhead structure which is to form a part of the new Rapid Transit line, and the proposed bridges which are to span the East and Hudson Rivers, shall be commensurate in dignity and beauty with the metropolis of the greatest industrial country in the world.

THE ARNOLD SYSTEM OF ELECTRICAL TRACTION.

The question of the employment of high-tension alternating currents for long distance or heavy traction has not received the attention that the subject deserves from the American engineering fraternity at large. As a result, the German and other Continental engineers, who have been continually striving to reconcile the demands of the traffic problem with the limitations of the alternating current motor, have, until recently, made much more progress toward a satisfactory solution of the problem than has been made in this country.

It has, however, gradually come to be generally conceded even here, that the direct current, embodying though it does tremendous advantages along the line of speed regulation of the motors, is hardly to be looked to as presenting in the present state of our knowledge a satisfactory solution of the traction question. The difficulties in the way of an economical distribution of the current have thus far proved an insuperable obstacle. In the attempt to conquer this difficulty various expedients have been resorted to, but expedients they have remained. Even the combination of high-tension alternating currents converted to direct low-tension working currents by rotary transformers has proven unsatisfactory to the man who pays the bills, since the loss of energy at conversion, the first cost of substation installation, with the subsequent cost of substation maintenance, together with the cost of the copper wire which it was even then necessary to string between substations if the traffic were at all heavy, almost entirely neutralized the advantages obtained by the initial employment of the alternating current.

At the same time the single-phase alternating current motor has presented, until recently, even less hope of a final solution of this problem than the direct current motor. Practically unalterable as regards speed, low starting torque, and an inability to adapt itself to an overload have rendered it almost impossible as a railway motor, and while the three-phase machine removed many of the difficulties enumerated above, the complexity of conductors presented so many difficulties in the way of transferring the current to the motors that the last state of affairs was but little better than the first.

With traction engineering affairs in this condition the importance of the announcement of Mr. Bion J. Arnold at a recent meeting of the American Institute of Electrical Engineers can hardly be overestimated.

The simplicity of his basic idea illustrates how easily mankind, by continued contemplation of almost any given series of conditions, becomes convinced that the conditions are necessities.

The proposition, somewhat in detail, is as follows: Each motor car is to be equipped with a single-phase alternating current motor of which *both* the armature and field are capable of revolution about the common shaft, either separately or together. Attached to armature and field are two engines, one to each, which are so constructed that they may be used either for compressing air which is stored in a reservoir carried on the car or for driving by means of the compressed air the portion of the motor to which they are fastened. The motor which is designed to fulfill the average propulsion requirements of the car, is intended to be maintained at a constant speed (synchronous with the driving dynamo) and at a constant load.

Let us now consider the behavior of the device under normal running conditions with the field magnet at rest (with respect to the car) and the armature, to which is attached the car wheels, rotating at its constant speed. (A constant speed is, of course, undestood to mean that a given point in the armature passes a given point in the field a given number of times per second; whether this relative motion is obtained by the rotation of the field or of the armature is of no consequence.) If it be now desirable to slow down the motion of the car the field is released from the clutch which holds it motionless (with respect to the car) upon its shaft and the reaction of the force which until now has been driving the armature causes the field to rotate in the opposite direction. The engine attached to the armature is, at the same instant that the clutch is removed from the field, started compressing air; this increase of the load would tend to decrease the speed of the armature in an ordinary type motor with fixed field, but as the field is here free to revolve, the effect of the increased load on the armature is simply to accelerate the backward motion of the field, and thus the synchronism or relative speed of motion of the parts is maintained. By gradually applying the brakes the actual rotation of the armature is gradually diminished while a proportional increase in the velocity of the field is taking place until such time as the car comes to rest, when the armature has ceased to rotate and the field is revolving at the constant speed necessary to maintain synchronism with the driving dynamo, and incidentally, during all this time the field has been actuating the air-compressing engine attached to it and consequently has largely succeeded in storing the kinetic energy which the moving car possessed. During the whole time of car stoppage the field continues to revolve, and the field engine to compress air in the reservoir.

To start the car again in motion the brakes are released and the field engine gradually throttled, and as this latter, of course, has a tendency to slow down the rotation of the field, the armature in order to maintain synchronism is compelled to revolve, thus starting the car. In addition the connection between the armature engine and the reservoir is changed so that the engine is actuated by the compressed air and this of course assists in rotating the armature. By gradually throttling the field engine, the field revolution is eventually entirely stopped, at which time the speed of synchronism is that of the armature. Speeds greater than this may be secured by changing the connection of the field engine and the reservoir in such way as to actuate the engine by the stored air, so that, as the engine is made to drive the field in the same direction as the armature is rotating, and as the armature is compelled to maintain a given speed with respect to the field, the resulting speed of the armature will be the sum of the synchronism speed of the motor and the actual speed of the field.

In this way an infinite number of speeds may be secured while the relative motion of the parts of the motor remains constant. In ascending a grade the natural capacity of the motor is augmented by the engine of the armature, which, connected with the reservoir as in starting, assists the armature rotation. While in descending a grade the energy of the motor may be entirely converted into energy of compressed air by the proper connection of the engines.

Another tremendous advantage which this system offers is that each car, after having been run for a given time, is independent, by virtue of the energy stored in the air tanks, of the main line, and being an independent unit can be shunted and switched across tracks not electrically connected with the main line for a time dependent upon the capacity and contents of the reservoir. In passing through communities where it is undesirable, for any reason, to have the high-tension wire or contact-rail, the car can proceed under its stored energy without any electrical connection whatever; or if the district to be traversed is so extensive as to introduce the possible danger of the air reservoir being emptied it would be possible to provide a static stepdown transformer at the territorial limits which would supply a working current of such potential—say 200 volts—as to be well within the danger limit. The motor would then work directly from the line.

Requiring, as the system does, only a single-phase motor, the ordinary third-rail or overhead construction can be used, always provided that the high potential required be met by proportionately high insulation. In fact, this latter condition seems to be the one weak point in the scheme; a 15,000-volt potential hardly being a desirable accompaniment for any third-rail system now in vogue, and even an overhead naked conductor will present difficulties in the way of insulation, particularly in wet or winter weather, that will make a most careful consideration of this subject absolutely necessary.

It is the present intention to take the current direct from the high potential conductor at 15,000 volts and transform it through a static transformer situated on each car to a working voltage of 200 volts. Under conditions which did not necessitate the use of the high potential conductor the transformer might be done away with, but even under such conditions which would eliminate the saving occasioned by the transfer of energy, at high potential, the system would still show a greater efficiency than any now in use.

The saving of energy at the car end of the line does not by any means represent the major portion of the saving effected. In consequence of the fact that the motor is maintained at constant speed under constant load, it is quite evident that the variations of load usually so exceedingly noticeable at the power station will be done away with. It will be, therefore, possible to build and equip the power house of such a line of such units that it may be constantly working at its maximum efficiency—a condition toward which the engineering effort of to-day is constantly striving.

To discuss the situation as briefly as possible, the advantages are these:

1. By keeping the motor at constant speed under constant load it is possible to have it always working at maximum efficiency.

2. By having the various line motors always carrying the same load, the variations usually evident at the power house will be considerably decreased.

3. By the use of the alternating current motor, the elaborate system of rotary converter substations will be eliminated which will effect a considerable saving both in installation and maintenance.

4. A very large saving in energy will be effected, due to the fact that the energy now wasted at the brakes and in descending hills is stored up for future use.

It is of course needless to say that in view of the high potential of the working conductor a very considerable saving in the installation of long distance roads will be effected.

The only defect evident from a theoretical consideration of the case seems to be the difficulty of properly insulating the working conductor. It will be necessary also to watch very closely over the metallic continuity of the return rail, since even in fairly moist ground a break such as does occur sometimes in spite of the most careful bonding would introduce an element of danger not to be neglected. It may be said, however, from a consideration of the plans that the system opens a new era for traction engineering, and Mr. Arnold is to be congratulated for the ingenuity which he has displayed in surmounting the difficulties which beset his path.

VOCAL SOUNDS OF FISHES.

BY PROF. CHARLES FREDERICK HOLDER.

In the latter part of the summer of 1899 the fishermen brought me two very interesting fishes, which were kept in the tanks for months. They were known to science as *Porichthys notatus*, the popular names being midshipman, singing fish and star gazer. In a general way the fish resembles the cat fish. It is about fifteen inches in length; the head flat, the eyes on top of it and capable of being depressed out of sight when the fish is touched. The prevailing color is a deep blue; the mouth is large and armed with an array of sharp recurved teeth, a remarkable series of pores, and a still more remarkable series of silver spots almost identical with the so-called eye spots seen in Scopelus and others so far as appearances go, yet so far as known not phosphorescent organs. These silver spots are arranged along the sides and upon the lateral ventral surface in a curious design, and resemble the heads of pins driven into the flesh. Each is a round piece of silver-colored membrane, which shows through the skin, above which is a pair of flaps with fringes; between each flap lies a pore.

The fishes habitually lay on the bottom of the tank, rarely moving except when fed; but occasionally they would wriggle to the surface and lie there, displaying the wonderful arrangement of pearly or silver "buttons," which have given the title of midshipman to the fish. The building in which the fishes were kept was sixty feet in length, and while standing at the end one day I heard a loud "umph"-like sound—with heavy accent on the *m*. As I stood and listened, it came again—"umph," so loud that it could have been heard twice the distance away. I turned in the direction of the sound, and when I reached the tank of the midshipman I saw that the jaws of one were stretched outward, and again came the remarkable sound, "umph," which resembled the "word" many monkeys utter when grunting their displeasure or pleasure, but so loud and resonant that although I had heard various fishes utter sounds, I was amazed.

Later I took one of the fishes from the tank and carried it the entire length of the building to a dissecting room, and during the passage the fish uttered the sound continually, attracting the attention of the visitors. This sound is made with the air bladder of the fish, but is not so remarkable as what might be termed the musical sounds of the fish. An acquaintance while walking on the sands of San Diego Bay, very early in the morning, heard a singular murmuring sound. It evidently proceeded from the water, and presently so increased in volume that the listener stood for some time trying to trace it. Finally with the aid of a boat he discovered that the sounds came up from the sea, and emanated from a school of midshipmen. To the observing fisherman along shore, and especially at San Pedro, the music of the fishes is familiar, but it rarely happens that a landsman has the opportunity of hearing it.

My informant stated that the sounds were perfectly musical—a murmuring sound, which rose and fell with a certain rhythm, and that it was a remarkable performance not alone for the loudness of the notes, but for their musical quality.

A very intelligent Venetian fisherman at Avalon informed me that he had often heard the sounds of this fish, and at times in deep water; the peculiar murmuring notes rising and falling, then dying away suddenly to come again.

The late Spencer H. Baird once told me that he had heard the remarkable sounds made by the drum fish of the Atlantic. Wishing to investigate the subject, he made inquiries among the fishermen and learned that they frequently heard the sound, and they willingly agreed to take him to a spot where he was amply satisfied that the drum fish utters sounds—sounds so like a drum, a strange uncanny "boom-boom-boom," that not a few sailors have ascribed them to a more superstitious cause than the common drum fish, which utters them partly by grinding together its pharyngeal bones.

The drum fish is not the only one of its group which utters sounds. Nearly all produce them to a greater or less degree; some being just audible, others loud and distinct. Some years ago a British officer reported that a fish of this group uttered such loud noises that the fishermen at a certain point were alarmed, and attributed it to some supernatural cause. He heard the sounds and described them as resembling the twanging of an immense harp and the beating of a drum. As with those previously described, the sounds varied, being low, a sort of murmur at first, then increasing until there was a babel of strange sounds. It was thought in this instance that the fishes must have clapped their jaws together to produce them, so loud and resonant were they.

One of the most remarkable sound producers it has ever been my good fortune to listen to was a Haemulon of the Gulf of Mexico—one of the wide-mouthed, highly-colored grunts so common on every portion of the reef. I never succeeded in hearing this sound beneath the water, though I passed many hours lying on a platform I had built at the surface, beneath which were hundreds of grunts unsuspicious of my near proximity. They were constantly engaged in games, chasing each other about, now approaching one another, opening the mouth wide and standing perfectly still; then retreating, and at this time, if any, the sounds must have been uttered. The moment I took one of these fishes from the water it began to grunt: "Oink-oink-oink"; now with one prolonged "o-i-n-k," then strung along rapidly, as though to intensify its agony; all the while it rolled its large eyes at me in a comical manner. No one in listening to such a remarkable outcry from a fish could refrain from wondering whether it had any significance; in other words, the impression was created that it was barely possible that the sounds were repeated in the water, and that they represented a very primitive attempt at vocal communication among fishes; but, as I have said, the sounds were never heard rising from the multitude of grunts, which swam about beneath my improvised screen, and the most plausible theory is perhaps that the sound *oink* is the only one the fish can utter, and that it is accidental or involuntary, though in the case of the midshipman, whose voice I heard sixty feet away, and which appears to "sing," there must be some different explanation. The murmuring sounds have some significance or meaning.

Several years ago I witnessed a sudden run of dog fish—a small shark on the New England coast. In the morning the men were cod-fishing on the banks, but suddenly the dog fish "set in." They came in countless thousands, destroying the fishing; a ravenous horde, fairly filling the water and eating even jelly fishes to satisfy their hunger. No sooner did a bait strike the water than several rushed at it, and the boat near me had the sail, which was dragging overboard, torn in pieces by them. The fishermen immediately changed their tackle and began fishing for dog fish for the livers, which were valued at a cent apiece, soon filling their boats. As the fish were hauled in they uttered loud croaks sounding like "r-o-i-k, r-o-i-k," and this was heard from scores of snapping mouths in concert. In this instance it seemed to require no little effort to produce the sound, and it may have been, in all probability was, the accompaniment of a convulsive gasping for breath.

The sounds produced by fishes—and sixty or seventy or more are known to utter them—it is supposed are caused by the action of the pneumatic duct and swimming-bladder, or produced by the lips or pharyngeal or intermaxillary bones. The curious puff shark uttered a deep grunt when it was taken from the water. I heard this sound one day while on the beach at Avalon, and although I recognized it, I could not see the fish. Finally after hearing it repeated a number of times I traced it to a hook near by where a fisherman had, with the usual indifference to the feelings of sharks, hung the fish by the gills. The grunt may have been involuntary, but I chose to construe it into a plea for mercy and unhooked the shark and placed it in the water, where it swam away, its voice, in this case, having saved its life.

The carp utters a low sound, and a sunfish which I kept, often came to the surface and uttered an audible clicking sound. Some of the gurnards utter a murmuring sound; many of the cat fishes produce sounds and the eel and moray are said to have the same power. On the Maine coast, near Ogunquit, I once found a remarkable eel settlement, and spent much time drifting over the spot, listening for the sounds made by them, handling many as they crossed the rocks at ebb tide to reach the sea, but I was never repaid. Dr. C. C. Abbott, who has heard the sounds uttered by eels, states that they are the most musical of those of any fish observed by him. I have handled and experimented with Florida and Southern Californian morays, with a similar object in view, but without results. It is believed that the sounds are produced by forcing air from the swimming-bladder into the oesophagus, and according to the authority quoted, the note of the eel is often repeated and has a slight metallic resonance.

The little sea horse has a note, though I have always failed to hear it; but I have listened to the low growling croak of the semotilus of the St. Lawrence, and more than once tossed a fish back for its pains and I might say its vocal reproaches, and I have heard the croak of the California "big head." A whirring sound is said to be uttered by the gizzard shad—*Dorosoma cepedianum*—while the chub has a single note, probably produced by the air-bladder, as a discharge of bubbles has been noticed after it. When the sounds of fishes can be caught in the phonograph, and some careful observer devotes his attention to the subject and makes an exhaustive study of it, the results will be of more than ordinary interest.

SCIENCE NOTES.

Bessel in 1831 first determined the mass of the rings of Saturn by observing the motion of Titan, his largest satellite. The approximate mass obtained is admittedly large. Professor Hall, in a recent number of the Astronomical Journal, has determined the mass of the ring to that of the planet as 1 to 7,092. This gives the ring a mass only two-thirds that of Titan, whose mass is to that of Saturn as 1 to 4,500.

Desmoulieres has examined the coloring matter and sugars contained in apricots. He finds that the former can be removed from both acid and ammoniacal solution by amyl alcohol, and appears to be identical with carotin. The sugars extracted were saccharose, invert sugar, and glucose, the proportion of the latter being small in ripe fruits, but larger in unripe fruits (0.353 and 0.771 per cent respectively).—Bull. des Sci. Pharm.

The captain in charge of the lightship situated at the southwest channel of the bar at the entrance of San Francisco Harbor recently reported to the United States Lighthouse Commissioner that on the 15th of September a large number of land birds took refuge on board the vessel. A dense smoke from northern forest fires hung over the locality and completely obscured sea and land. Evidently the birds had lost their way and, exhausted by their long flight, the wanderers lighted on the ship undeterred by the presence of the crew. At one time sixty of the feathered guests were counted on various parts of the ship. Owls, cranes, humming birds and other non-marine species were noticed during the time. The swarm continued during the prevalence of the smoke, but vanished when the weather cleared.

Lieut. Peary has brought home news of a mysterious epidemic which is raging among the Esquimaux. Indeed, so terrible were the ravages of the disease, that many of the Esquimaux at Smith Sound begged him to take them south. Twelve years ago the Esquimaux numbered 300. In 1897 Peary found that their number had been reduced to 234. It is now probable that these most northern inhabitants of the globe do not exceed 200 in number. This is but one instance of a great number that may be cited. All through the Arctic region the inhabitants are fast disappearing. The Alaskan Esquimaux have been decimated. When explorers first went among them, their number was believed to be from 2,000 to 3,000. Now it is thought that hardly more than 500 people can be counted from Point Barrow to the Aleutian Islands. The lot of these unfortunate natives has been made harder to bear by reason of the destruction of sea life by the whalers who harried the Alaskan coast. The extermination of the seal, walrus and polar bear have likewise done their share to embitter the cup of the northern races. In southwest Greenland a similar condition of affairs exists. The ten thousand natives are barely holding their own, although largely aided by the Danes. Labrador natives are likewise decreasing. Twenty years ago they numbered 30,000; now they number barely 15,000 souls. Two decades ago the entire population of the North was estimated at 30,000. It is probable to-day that the number has been almost cut in two.

A PUNCH CENTERING DEVICE.

BY THOMAS C. HARRIS.

Every mechanic who has occasion to punch holes in iron with a hammer and hand-punch, realizes how difficult a matter it is to place the punch in the exact position that it should be, over the hole in the die or punch-block.

The piece to be perforated is necessarily between his eye and the hole in the die, and, of course, conceals the exact spot where the point of the punch should start.

As usually done, a blow or two on the punch will show him *about* where the proper place is, but the iron is bruised and a clean punched hole not often secured.

In the regulation punching press, where the punch rises and falls with the thrust of the machine, its point exactly entering the hole in the die or block to receive it, the result is often as good as a drilled hole, with clean and sharp edges when the disk of metal has been accurately sheared out.

A simple device to center a hand-punch over a punching block or die, and thereby secure accurate work, is shown in the sketch.

The forked casting has sharp points on its lower extremities, where they rest on the bench or floor. At its upper end the fork is expanded into a disk and carries a short piece of pipe or sleeve, which is swiveled to it and secured by a wing nut. This allows the sleeve to swing in any vertical angle and may be fixed by the wing nut.

A short rod passes through the sleeve and is secured in any desired position by a thumb-screw.

At its free end the rod terminates in a disk, with a ring bolt and wing nut, to embrace the hand-punch. As shown, the punch is held vertically, but it may be inclined at any angle to suit the work.

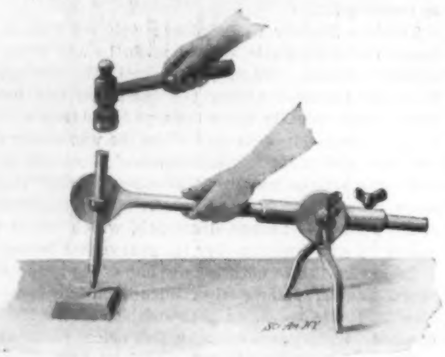
It is readily seen that with this device the point of the punch may be instantly placed in position, to exactly register over the hole in the die, and while in that position the free end of the apparatus may be lifted and the piece to be perforated placed in position.

The lifting of the punch causes the device to rise or swing on its two sharp extremities, without slipping, and the punch returns to its exact position as predetermined on. A blow or two of the hammer drives out a disk in the metal and a clean-cut hole is the result.

This arrangement may be used to punch holes in any stock not too heavy for a hammer and punch method, either in the shop or the field, and the system allows a very accurate spacing of holes.

In shops or places where a regular punching press is not available this device will be found practical and useful.

It was designed by the writer for his own use and is not patented.



A PUNCH CENTERING DEVICE.

THE INCLINED PLANE OF THE MORRIS CANAL.

One of the most interesting historical transportation routes of this country is the old Morris Canal, in New Jersey, with its curious inclined plane for raising canalboats over considerable elevations. In the era before the introduction of railroads, considerations of the cost of construction and time of operation of locks naturally led engineers to seek for some more expeditious and cheaper means of overcoming elevations. This led to the occasional adoption, as in the Great Western Canal, England, of perpendicular lifts, and to the more extended use of inclined lifts or planes, the latter having proved to be at all times the more economical. Inclined planes seem to have been first used by the Chinese, but their modern application to canal systems is due to Mr. William Reynolds, who used them in 1792 on the Shropshire Canal, England. Subsequently, the system was carried into extended use throughout the canal system of England.

The Morris Canal was chartered in 1825; begun July, 1825; completed from the Delaware River to Newark in 1831; extended to Jersey City in 1836, and its planes and lock chambers were enlarged in 1841. Originally the dimensions of the canal were: bottom width, 20 feet; top width, 32 feet; depth of water, 4 feet; locks, 9 feet wide by 75 feet long. The planes were constructed on various plans, there being twenty summit and three lock planes in all. In 1845 the canal was enlarged to a bottom width of 25 feet, top width of 40 feet, and the depth was increased to 5 feet. The section boats, jointed in the middle, were first introduced in 1845. They carried cargoes of 45 gross tons. In 1850 and 1860 all the planes were altered to summit planes and adapted to wire rope haulage. The most remarkable of these is the one near Washington, New Jersey, which has a rise of 100 feet in a length of 1,600 feet. The summit of the canal is at Fort Morris, 41.34 miles from the Delaware River, and 60.80 miles from the Hudson River. The whole length of the canal is 102.14 miles. The boats, which are constructed in two sections to accommodate them to the changes of level of the planes and the canal levels, are jointed together by latches and steadying pins, the ends bearing against each other. Transverse bulkheads separate the two compartments of the boat, each of which is actually a boat in itself. While the average tonnage is about 65 tons, the planes can transfer boats of 100 tons weight. The trucks, like the boats, are divided into two sections, each section having eight wheels with double flanges on the wheels. They are provided with strong stanchions to which the boats are fastened with hawsers. The tracks on which the trucks travel are carried a short distance under the water of the lower bay and rise up the incline above the water level of the upper reach, then descend into the upper reach and run a few feet along the bottom. The grade of the inclines is in general about one to eleven. The planes are worked by reaction waterwheels, and the levers for regulating the supply of water and for the control of the brakes are in charge of a man who is located where he can see the whole of the plane. He is stationed in a building containing the waterwheels and other machinery, which is usually located midway between the top and bottom of the plane, and at the end of the flume. As indicating the relative economy of this system, it should be mentioned that the quantity of water needed for these wheels is less than one-twentieth of the amount expended in a series of locks of the same total height or lift. The wire cables are so arranged that as one winds upon the drum the other unwinds. The two ropes pass around submerged horizontal sheaves at the bottom and top of the plane. The car has a wire rope attached at both ends, the back rope to one section and the main rope to the other. To draw a car out of the lower reach and up the plane into the upper bay, the engineer turns the tubwheel, which lets the water into the reaction waterwheel, and the drum winds up the cable at one end and unwinds at the other, drawing the car up. In descending, the water is shut off from the wheel, and the car is allowed to descend by its own weight.

Although the system is an exceedingly old one, there is no doubt that this method of transfer was well adapted to the needs of the canal at the time it was built. There are certain undoubted advantages in the system as compared with the system of locks; for although one lock is more economical than a short plane, a single plane is more economical than a series of locks of the same total lift, the economy being chiefly in the items of water and time. While a plane entails more machinery, etc., it does not involve so much as to make it more expensive than five or six locks in series. In conclusion it must be remembered that what has been said applies merely to canals of small capacity such as this old Morris Canal. The system would not be applicable to a modern canal of large size and capacity.

Commencing the Ascent of a Plane.

Building Containing Waterwheel and Winding Drum.

At the Summit of an Inclined Plane—Car and Boat Entering Upper Reach.

THE INCLINED PLANES OF THE OLD MORRIS CANAL.

MAKING A PHOTOGRAPHIC LENS.

Photography as a pastime holds the infatuated attention of thousands of people, old as well as young, to whom the possession of a camera is a necessity, awakening, as it does, a higher sense of the beautiful in nature and a growing love for the artistic as well as useful phases of photographic work. To take good pictures is a delight; to understand the chemistry of photography makes it fascinating; to watch the comparatively simple yet wonderfully interesting processes through which a piece of glass must pass before it is useful as a high-grade photographic lens


FIG. 1.


FIG. 5.


FIG. 10.

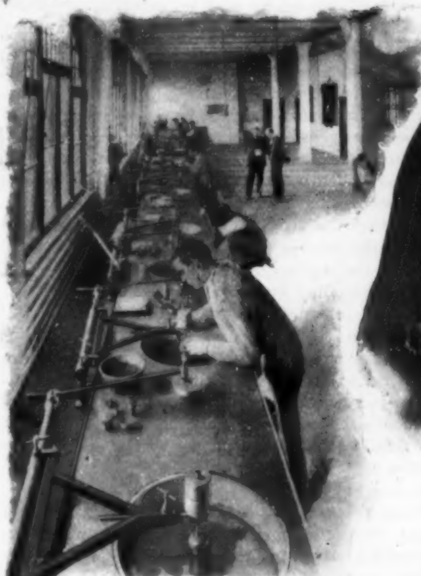


FIG. 2.


FIG. 6.


FIG. 11.

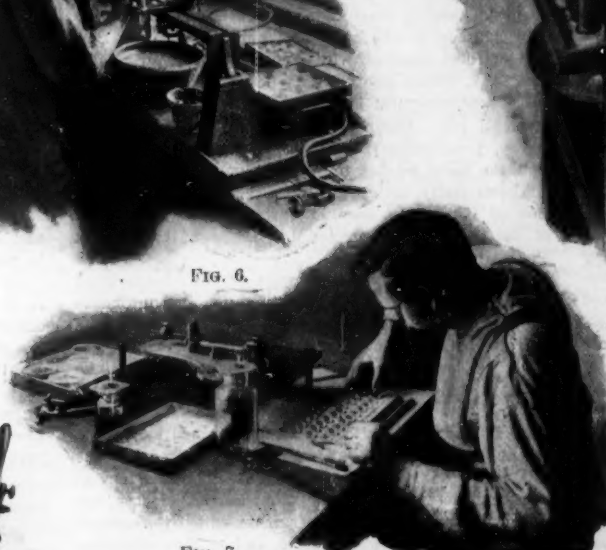


FIG. 7.


FIG. 12.


FIG. 3.


FIG. 8.


FIG. 13.


FIG. 4.


FIG. 9.


FIG. 14.

VARIOUS PROCESSES IN THE MANUFACTURE OF A PHOTOGRAPHIC LENS.

—the most important element of one's whole outfit—is an education, giving a clearer idea of the value of a first-class lens, establishing the fact that science is required in lens making. In fact, to the uninitiated the precision required in manufacturing high-grade lenses is astonishing, the greatest possible accuracy of calculation, to say nothing of care in grinding, polishing, etc., being necessary before a lens is ready for use in the camera.

Nowhere else in the world is there so large a manufactory of photographic lenses as that illustrated by the accompanying engravings from views taken in the works of C. P. Goerz, at Friedenau, near Berlin, Germany. The pictures herewith give no idea of the extent of the factory, which is four and a half stories in height, but they do clearly illustrate the various lens-making processes.

Few manufacturers of photographic supplies have made more rapid strides than the optical institute of C. P. Goerz, which was founded in 1888 as a small shop with three workmen. Four years later the number of workmen had increased to seventy, and a rapid growth in the business followed the introduction in 1893 of the double anastigmat lens, constructed according to the calculations of Herr v. Höegh, the scientific assistant of the firm. Eight years after founding the business, in 1896, the number of workmen employed had risen to 350, necessitating the building of the factory mentioned above, accommodating a force of 700 men. The output has steadily increased, making extensions necessary, and branch factories have been established in Winterstein (Thuringia) as well as in New York city.

The glass from which some of the smaller, as well as some of the larger, sizes of lenses are made is obtained in the shape of blocks such as are shown by one of the accompanying engravings (Fig. 14), the intermediate sizes being made from glass which was roughly moulded into shape while in a hot, semi-plastic state. At one time all sizes were made from square blocks of plate glass, in the use of which there was of necessity considerable waste of material in that the corners had to be chipped or cut off, causing a waste of time as well as labor. The glass must be of the very best quality, free from spots and strains, and as transparent and colorless as possible. What are termed the "optical constants" of the glass are ascertained, and the blocks are properly marked and cut up into slabs of varying lengths and thicknesses by means of thin galvanized iron disks whose cutting edges are set with diamonds. This operation is clearly illustrated by Fig. 9, where two workmen are shown, one cutting off the corners of a block of glass, the other having a block in the machine and measuring the thickness of another in his hand.

The corners of the glass blocks are broken away by means of flat pliers called shanks, this operation being known as shanking or nibbling, giving a rough approximation to the required circular form of the lens. This having been done, the glass is ready for the various grinding operations. First the "blank" is reduced to the required thickness by grinding with wet sand on flat rotating cast-iron disks in the manner indicated by Fig. 12. The edges of the glass blanks are smoothed by rotating disks in the edge or face of which are recesses for that purpose. Then follows the rough working of the curved surfaces or rough grinding, which is done in the shop, shown by Fig. 2.

In the rough grinding process the workman holds the glass with both hands and presses it against the rapidly rotating grinding shell, as indicated by Fig. 1, the grinding shell being kept covered with wet grinding sand, the operator being careful to have the grinding action continuous and evenly distributed over the entire surface to be ground or shaped. The cast-iron grinding shells, of which several types are shown in the foreground of Fig. 8, are either concave or convex, according to the shape of the lens to be made. Upon the uniform exactness of the shape or curve of the grinding surface depends the quality of the lens, and for this reason the shells are frequently examined for imperfections due to uneven wear, being discarded when they are found to be inaccurate. Skillful grinders, by exerting uniform pressure, preserve the proper shape of the shell until it is entirely worn out, which occurs when about a hundred of the medium size lenses have been ground.

From time to time during the rough grinding process the lens is tested with calipers and gages or templates, the latter consisting of brass plates the edge of which is given the same degree of curvature as the lens being ground, but in the opposite direction. In other words, a convex template is necessary in testing the curvature of a concave lens and vice versa. The workman places the template vertically on the lens and ascertains whether the edge of the template touches the lens at all points. The calipers, of which several are shown in the views herewith (see Figs. 1, 8, 11, and 12), consist of two aligning rods between the points of which the thickness of the lens is measured. The rods may be moved toward or from one another, one of them being graduated, a vernier indicating the distance between the points of the two rods and hence the thickness of the lens within one-twentieth of a millimeter.

Having been rough-ground to its approximate shape and thickness the lens is ready for the final grinding operations, the truing or figuring, and polishing. The truing or figuring is accomplished by using shells similar to those employed in the rough-grinding process, but the grinding materials are of finer quality, and the shells are mounted in machines or "mills" driven by foot pedals, the object of this arrangement being to secure greater accuracy. An enlarged view of one of these "mills," showing an operator engaged in "figuring," is presented in Fig. 11. The operation of figuring requires a degree of accuracy of which the uninitiated can have no adequate conception, for mechanical measuring instruments such as one would think might be employed fail to meet the requirements of accurate testing, and resort is therefore had to the observation of a physical phenomenon known as Newton's interference rings, which make their appearance with the prismatic colors of the rainbow, when the lens being ground is pressed closely upon a testing glass, of which several are shown in the extreme foreground of Fig. 14. The color, location, and regularity or irregularity of the rings indicate any departure from the correct surface, the test being so delicate as to clearly reveal the existence of an error as small as one ten-thousandth of a millimeter.

In order that the lens may be pressed evenly upon the rotating grinding shell the workman by means of a special sealing wax fastens it to a handle such as may be seen in the operator's hand (Fig. 11). Several of these handles, with lenses attached, are shown in Fig. 8, which also shows types of "common" holders to which several lenses are secured when they are of small size. Figuring is done exclusively with wet emery, progressively finer as the lens nears completion, the finest serving to give the lens surface its final mathematically correct shape, a most careful supervision of the results secured during the several stages of the work being effected by means of the testing glasses referred to above.

Polishing is the final operation of the lens-forming process, and this is done with rouge on automatic polishing mills such as are shown in Fig. 2. The operator covers the polishing shell with pitch into which he presses the lens, to the shape of which the pitch is thus carefully moulded. The polishing powder is then applied and the shell rotated. This operation of polishing is also constantly watched by the aid of the test glass, the average time required for the completion of the process being one day for a lens of five centimeters diameter. The finished lenses are again measured with an instrument called the spherometer, as illustrated in Fig. 10, and at the same time they are examined as to flaws in the glass. Small air bubbles are not detrimental, but lenses with spots or strains, the latter causing irregular refraction, are discarded, and the percentage of rejected lenses, or waste, is quite considerable, lack of skill on the part of the workman also often spoiling valuable lenses.

Bearing in mind that the modern anastigmat lenses contain from six to ten lenses in combination, and that the above-mentioned waste must of necessity increase the cost of production, it becomes apparent that such lenses must be high-priced because of the difficulties encountered in making a single perfect lens. Another factor which increases the cost of manufacture is the variation in the optical properties of the material furnished by the glass makers. Glass blocks forming part of different shipments from the glass works are almost never absolutely alike in their optical constants, and owing to this fact it becomes necessary to frequently repeat the calculations of the proper shape of the lenses, necessitating new grinding and polishing shells, new testing glasses, etc.

Putting the single lenses together to form systems or groups is the next operation. After being cemented together the lenses are centered by means of lathes of great precision, the lens being fastened to the end of the lathe spindle by means of putty. Looking into the lens, the operator then ascertains whether the images or reflections of any bright body therein remain stationary while the spindle is rotated. If necessary in order to fulfill this requirement he shifts the lens in the soft putty, and by means of a testing lever on the tool-rest of the lathe, as indicated by Fig. 6, the axis of rotation of the spindle is brought into coincidence with the optical axis of the lens. Then follows the grinding of the edge of the lens in the manner indicated by Fig. 5, and as soon as the proper diameter is attained the lens is removed from the spindle and combined in the joining room with a mating lens that has been treated in a similar manner. The Goerz double anastigmat lens consists of two equal halves or combinations, each containing three lenses, which are joined or cemented together with very thin layers of Canada balsam.

After carefully cleaning the lenses and coating them with warm balsam the operator presses them well together, as indicated by Fig. 7, placing them upon the joining plate of the leveling apparatus illustrated by Fig. 4, in order to center them, a balanced testing lever being used to reveal even the slightest inaccuracy in the position of the lenses. Having thus been combined the completed systems of single lenses are thoroughly examined as to their optical qualities by means of testing apparatus such as is shown in Fig. 13, located in a room from which light is excluded. A piece of ground glass ruled horizontally and vertically by equally spaced lines, and lighted from behind by a small incandescent electric lamp, serves as a testing object, which may be shifted to the right or left at will by the operator as he looks through the lens. The images of the lines as formed by the lenses must be clearly defined in the optical axis and also at a distance from it, and when the objective is turned about its axis the image of the object should remain stationary. The best or most favorable distance between the two lens combinations, that is, the interval with which the clearest definition is obtained, is also determined by the above apparatus within one-twentieth of a millimeter. Though this distance may have been determined beforehand by calculation, small corrections, of which careful memoranda are taken, are always necessary.

This having been done the lens systems are sent to the mechanical workshops, where they are mounted, and upon the character of the mounting almost as much depends as upon the perfection of the lenses, the greatest possible mechanical accuracy being necessary to assure the proper fitting of all the parts. The blanks for the mounts are turned, the tubes are sawed apart, and the flanges soldered in position in large shops, the threading and turning being done on specially designed automatic screw-cutting lathes like that shown by Fig. 3. Being assembled, the objective is now ready to be placed in the testing apparatus for examination as to its working as a whole. If the definition is as good within an angle of sixty degrees as at the axis, the objective is pronounced satisfactory, and is finally passed through the engraving machine to receive the proper inscription, etc.

As a concluding test, the objectives are examined in a testing studio to determine their photographic efficiency by taking pictures of large testing plates, the preceding tests being of a purely optical character. By these repeated tests for accuracy the buyer of such a lens as has been described in the processes of its manufacture is assured of getting only first-class goods and correspondingly satisfactory photographic results.

The Current Supplement.

Mr. Perkins concludes his interesting illustrated description of the new Berlin underground and elevated railway in the current Supplement, No. 1402. The utilization of wastes and by-products in manufactures is a subject which has been admirably handled by Henry G. Kittredge. Sir William Crookes recently read a paper before the Royal Society on "Radio-Activity and the Electron Theory." The paper is reproduced in full in the current Supplement. As a matter of comparative value, Professor J. J. Thomson's theories of radio-activity are likewise published. Readers will doubtless contrast these two papers with no little interest. The Report of the Bureau of Steam Engineering on "Liquid Fuel for Naval Purposes" is concluded. Among the minor articles may be mentioned those on the "World's Coal Production and Consumption;" "Oil and Grease Separator;" "Temperatures at Great Altitudes;" "A New Process for Treating Fine Iron Ores for Blast Furnaces;" "The Development of the German Chemical Industry," and "The Texas-Louisiana Oil Field."

H. L. Russell and E. G. Hastings describe a micrococcus, isolated from milk, the thermal death point of which is 76 deg. C. for an exposure of ten minutes. As the temperature is raised to about 70 deg. C. some of the cells begin to succumb, but a small residuum retain their vitality until 76 deg. C. is reached (Centr. f. Bakt., Zweit Abt., 8, 339). Using this organism, the investigators Russell and Hastings have carried out some interesting observations upon the increased resistance of bacteria in milk pasteurized in contact with the air. Heated in bouillon and in milk in closed vessels (sealed tubes) the thermal death point is approximately the same, viz., 76 deg. C., but in milk heated in an open vessel the organism survived a temperature of 80 deg. C. It was found that this resistance is due to the protection afforded by the membrane which forms when milk is heated while freely exposed to the air, for in samples of sterile milk which were "seeded" with the organism and heated in an open beaker to 80 deg. C., numerous colonies were obtained from the membrane on sub-culturing, while the milk below the membrane was sterile.—Nature.

Electrical Notes.

Connections have been made on the new telephone cable across Vineyard Sound between Vineyard Haven and the mainland, and communication by telephone has been established. The cable is four miles long, with terminals at Nobscot Lighthouse and Lamberton Cove, near Vineyard Haven, opening on the Atlantic.

The filament of an incandescent lamp is thrown into rapid vibrations in the cold state by the slightest disturbance. When the lamp is burning the oscillations readily die away. This is not due to a loss of elasticity, but is probably due to a magnetic damping effect. The incandescent filament may be kept in a state of vibration by the simple device of bringing a magnet into its neighborhood, provided that either the lamp or the magnet is fed by an alternating current.

Absolutely pure silver is produced in the United States mint by electrolysis of fine silver, using an electrolyte of silver nitrate with 1 per cent free nitric acid. From the bar of silver 0.999 electrolytic action throws the silver down in the form of crystals, which are washed. In melting these crystals the flux used is three parts fused borax and one part pure niter. The bar's second melting is made without a flux to remove the oxygen introduced by the niter of the flux. When the silver is thus melted it is stirred with a piece of dry wood as long as the action due to the presence of oxygen continues, then poured into a chalk-lined mold, the bar cleaned with a brush and dilute sulphuric acid, and after being rolled out is ready for use.—Mining and Scientific Press.

One advantage that often comes from the use of the electric motor for machine driving is the comparative ease with which it may be ascertained whether a particular piece of machinery thus driven is operating at its highest efficiency. This can be done by comparing the power consumed by the motor in driving it with the power used in driving another similar machine. For example, it has more than once been found that certain printing presses of a given make have been consuming from one to two horse power more than another similar press, notwithstanding that the makers pronounced their apparatus in perfect running order, and in consequence placed the cause of this discrepancy on the electric motor. A brake test of the motors or an exchange of motors quickly showed the fallacy of this contention, and an easing up of the bearings of the press in different places has usually sufficed to get rid of this waste of power. Increase of output of machinery driven by electric motors is, however, after all, the great desideratum which is achieved, and far outweighs in importance the several other advantages incidental to electric driving—the saving of head room, for example, the absence of long lines of shafting, and the avoidance of power wastes. Indeed, the value of the power, whether furnished by shafting or by the electric motor, as compared with the importance of increased product, is nearly negligible.—Cassier's Magazine.

The Centralblatt für Accumulatoren und Elemententkunde publishes details of tests carried out by order of the French Minister of the Marine with secondary cells of French manufacture—presumably for use on submarines.. The method of testing the durability of the cells was as follows: The cells submitted by the various manufacturers were connected up in series to form one battery, and were charged and discharged 250 times. A current of 330 amperes was used for the first charging operation for a period of four hours, and subsequent chargings were carried out with the same current for a period equivalent in ampere hours to a 50 per cent increase on the previous discharge from the battery. The discharge was carried out at 660 amperes, and was continued until the E.M.F. of any cell had fallen to 1.65 volts. Two chargings and dischargings were completed daily, and Sunday was observed as a rest day. The level of liquid in each cell was preserved constant by addition of water or acid during the period of the test. The cells which fell below 1.65 volts in less than half an hour from the commencement of any period of discharge were withdrawn from the series, and the plates submitted to a final examination in presence of a representative of the makers. The number of cells entered for the test was 21, these being submitted by thirteen manufacturers. The experiment continued from October 10 to March 17, and on the latter date only five cells were left as survivors of the durability test. The following are the trade names and final E.M.F.'s of these five cells: Heinz (1.860 volts), Union (1.790 volts), Metaux (1.772 volts), Max (1.714 volts), Fulmen-d'Arsonval (1.650 volts). Of the above five makes of secondary cells, the first four are manufactured exclusively with pasted plates. The maximum weight of accumulators for the French navy is fixed by the Ministry at 225 kg. The Heinz cell had a total weight of 181 kg., of which 106 kg. represented the weight of the plates.

Santos-Dumont's New Balloons.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Santos-Dumont is constructing a new airship at the Lachambre establishment, which will be the smallest dirigible on record. With this minute airship he proposes to make the trip across Paris and land at the window of his apartment in the Champs Elysées. For this purpose he is having a special balustrade constructed of copper tubes. The balloon measures 18 feet in largest diameter and has a capacity of 260 cubic yards. It is somewhat egg-shaped, with a long point, and the length is about three times the diameter. This shape has been adopted in order to prevent the pitching movement of the airship. The framework of light pine will be suspended about 6½ feet below the balloon by 44 steel piano-wires. In the center of the frame is a Clement gasoline motor of three horse power, weighing but 26 pounds. The flywheel of the motor is a bicycle wheel of only 1.8 pounds weight. The screw has 10 feet diameter and makes 200 revolutions per minute. It is to give the airship a speed of 16 feet per second. The basket is made of wickerwork and measures but 16 inches square and 35 inches high, weighing only 12 pounds. The envelope of the balloon is of varnished silk and weighs 66 pounds, while the total weight of the airship when afloat is 460 pounds. The balloon will contain an air-bag of 60 cubic yards provided with a fan, to keep it swelled out. The balloon is to be first filled with illuminating gas in order to place the suspension wires and make the adjustments; finally it will be filled with hydrogen. The airship is to advance with the large end first, like Capt. Renard's balloon "La France," which was constructed in 1884.

This airship, the "No. 9," has the same general form as the large airship, the "Santos-Dumont No. 10," which is also in construction at the Vaugirard workshops; the latter is to carry 10 persons. As to his proposed trip across the Channel from Paris to London, the aeronaut stated that he had received two propositions, each from a well known person who wished his name kept secret for the present, offering him a prize of $50,000 for such a performance. One of these persons allows the aeronaut only three trials, while the other allows him five. In view of these restrictions, Santos-Dumont is not inclined to consider the offers, and remarks that M. Henri Deutsch allowed a period of five years for the Tour Eiffel trip, a distance of but 7 miles. The persons offering the prize stipulate that as a means of precaution no other aeronaut than Santos-Dumont is to make the attempt.

In a conversation lately held at Paris between Mr. James D. Phelan, former Mayor of San Francisco, and Santos-Dumont, the question turned upon long voyages, such as that from Paris to San Francisco. The aeronaut said that he was prepared to make such a voyage, and that if a number of San Francisco gentlemen could be found to put up a prize of $200,000, he would construct an airship at his own expense and make the entire trip on board of her, completing the undertaking within a year.

Another French Airship.

Among the new airships is that of Messrs. Paul and Pierre Lebaudy, which is being constructed near Mantes, and the trials are soon to be carried out above the Seine, so as to avoid accidents. The balloon is 192 feet long and 36 feet in largest diameter, containing 3,250 cubic yards. It is of peculiar shape, being flat on the under side so that it acts to some extent as an aeroplane. During the trials the car will be provided with a guide-rope 160 feet long, which will be attached below to a float in the river, this to be heavy enough to prevent the balloon from rising. As the ascensional force is often very suddenly increased by the sun's rays falling on the balloon, it is designed to prevent a sudden rising due to this cause. It has been found that when the dispersion of a cloud allows the sun's rays to strike the balloon, this may increase its temperature as much as 40 degrees C. above the surrounding air. In a balloon as large as the present one the rise of temperature would cause an expansion representing cubic yards, suddenly increasing the lifting power by 1,050 pounds. It is estimated that a float weighing half a ton will be sufficient to provide for this emergency. The envelope of the balloon, which weighs 0.6 pound per square yard or a total of 976 pounds, is formed of a layer of stout cotton cloth pasted on each side of a sheet of light rubber. The outside is coated with a yellow protecting substance, recently discovered and known as "ballonnine." It is found that this increases the tightness and also gives protection from the sun's rays. The fabric thus constituted is very resistant and a piece a yard wide will stand a test of 3,500 pounds tension. Its impermeability is unusual, as tests show a leakage of hydrogen of but 8 cubic inches per square yard in 24 hours, or practically nothing. Below the balloon is suspended a frame 68 feet long made of steel plates and tubes braced with piano wire. It carries a 45 horse power gasoline motor which operates two propellers placed on the right and left of the frame, thrown on by friction clutches. These two propellers answer for the driving as well as the steering.

Automobile News.

Insuring against automobile accidents is a new business enterprise which has had its origin in the accidents arising from the use of horseless carriages. The policies are issued to cover losses in a single instance, and are made out either for $5,000 or $10,000. It is said that steam-propelled vehicles have been barred, not because they are more dangerous to drivers or less easily controlled, but because records have proven that horses are more easily frightened by escaping steam than by any other cause.

Dr. Robert Hessler, of Logansport, Indiana, recently made a thousand-mile journey in a gasoline automobile. What is of more interest, he kept a detailed record each day of the number of miles traveled, the amount of oil consumed, and the cost of repairs on the road. On figuring up he found that he had used up seventy-five gallons of gasoline, worth $8, and that 85 cents had been spent on lubricants. That was all that was actually spent in operating the machine. During the journey one of the wheels was sprung, a tire was punctured, and a few bolts were lost. The repairs thus necessitated involved an expenditure of $10. It is no doubt likely that a similar outlay would have been incurred with any vehicle on a thousand mile trip.

Word has just been received from Paris that Henri Fournier has once more accomplished the feat of breaking the world's record for the mile and the kilometer. The trial was made on a new testing course between Ablis and St. Arnoult, near Dourdan, and the official figures are 47 2-5 and 29 1-5 seconds, respectively, for the two distances. This beats the mile record of Mr. W. K. Vanderbilt, Jr., made in France last August, by one second, and his kilometer record by one-fifth of a second, and is better by four and two-fifths seconds than Fournier's record-breaking mile made a year ago on the Coney Island boulevard, during the Automobile Club of America's speed trials. The record is equivalent to a speed of 75.9 miles per hour, which is scarcely exceeded by the new "Twentieth Century Limited" when spurting to make up lost time between New York and Chicago. At the present rate of increase it will be a very short time before the automobile capable of developing a speed of one hundred miles an hour will be an actual fact. Both of Fournier's records, as well as Mr. Vanderbilt's, were made on Mors racers.

Artificial Graphite.

Mr. E. G. Acheson, of caborundum fame, has recently taken out a United States patent for a process of making artificial graphite. In carrying out his experiments Mr. Acheson had observed that by the direct passage of a heating current through a mass of coke, it was possible to free the coke of many of its impurities and to increase its conductivity to a marked degree. Later he discovered that carborundum and many other carbides might be directly transformed into graphite simply by volatilizing the non-carbon element. It followed almost as a matter of course that the conversion of carbon to graphite by any method of electrical heating, depended upon the presence in the carbon of carbide-producing elements. It likewise followed that the impurities should be present only in such quantities as to permit the progressive transformation of the mass of coke into graphite, carbides being formed and decomposed, the volatilized non-carbon element combining with adjacent portions of the carbon. Mr. Acheson found that an artificial mixture of carbon with impurities was unnecessary, since non-coking coals and certain varieties of charcoal contain the proper minerals. As the present patent states, the original distribution of volatile impurities is important. For example, petroleum coke in the form of lumps and in rough admixtures of iron or iron ore, can be suitably heated in an electrical furnace, thereby causing the vapors of the metal so to permeate the entire mass as to determine its complete transformation into graphite.

Work on the Canadian Niagara power plant is progressing rapidly. The tunnel will have a length of 2,200 feet from the wheel pit to the base of the Horseshoe Fall, where it will discharge into the lower Niagara River. From the shaft to the pit the distance is about 900 feet, and of this length there remains only 48 feet to be blown out. From the shaft to the portal the length is about 1,300 feet, and of this distance about 200 feet remain to be taken out. For the entire length the bottom bench remains to be taken out, but this can be removed quite rapidly. When this bench is removed the stone will be used for concrete work and backing.

USE OF PHOTOGRAPHS AS EVIDENCE.

BY JAMES G. MC CURDY.

Ever since its inception, photography has rendered valuable assistance to justice by the popular nature of the data it is capable of producing. One of its earliest services along this line was the improvement of the various "Rogues' Galleries" scattered throughout the country, where efforts were being made to keep a record of portraits of leading lawbreakers. Prior to the advent of photography, likenesses of criminals, as sketched by the artist and reproduced by the wood engraver, offered but little aid to the officers of the law for purposes of identification. The camera, however, capable of catching each facial characteristic and fleeting expression, together with the ease with which its results could be duplicated without loss of any essential qualities, proved a most effectual help in the detection of criminals.

The United States government endeavored for many years to perfect a system of identification by description merely, in the matter of Chinese certificates. But so many frauds were perpetrated that at last Congress was compelled to adopt the amendment of November 3, 1893, requiring every such certificate to have attached to its face the photograph of the person applying for the same. This clause in the Exclusion Bill was very distasteful to the Chinese, who fought it with great energy throughout the country, but without avail.

When at last the Chinese found that they must comply with the new regulation or suffer deportation, the photographers of the Pacific Coast could hardly meet the demands of the excited Celestials, all of whom had become very anxious to be photographed before the expiration of the time limit. Certificate photographs are not retouched, and any scar or other prominent marking upon the face is made as conspicuous as possible, to aid identification. The effect of the new law was most salutary, and while frauds are still occasionally attempted, they are rarely successful.

When the foregoing facts are taken into consideration, it is not at all surprising that the camera is held in wholesome respect by those who would seek to break or evade the law. This point was emphasized last winter during the great teamsters' strike in Boston, where policemen riding with the drivers found cameras more fomidable weapons than firearms would have been. Somehow, when those bent on mischief realized that any act of violence on their part would be duly recorded by the all-seeing lenses, to be brought up against them later, the very boldest among them shrank from making a demonstration.

Although the photograph has been used for years as a means of identification, it is still looked upon in many courts with a degree of suspicion, when submitted in general evidence. This is largely due to the fact that photographic negatives, in the hands of skillful manipulators, are capable of much "doctoring," and can readily be made to bear witness to untruths.

Yet realizing that all evidence is open to question and must be thoroughly sifted, and trusting to photographic experts to unearth attempted fraud, the photograph is being admitted in courts of justice as evidence more extensively each year.

Finding by experience that a well-taken, untouched photograph bearing upon a case in point often makes valuable evidence, many railroads, steamship companies and other corporations are making it a practice to keep cameras within easy reach of their employés, to be used when necessity arises.

CHINESE CERTIFICATE OF IDENTIFICATION USED IN THE UNITED STATES.

It has been decided to establish wireless telegraphy apparatus on all stations and on all passenger trains on Italian railroads. King Victor Emmanuel, of his own initiative, has, it is reported, recently appointed Signor Marconi a Chevalier of the Order of Industrial Merit.

ACETYLENE SEARCHLIGHTS FOR AUTOMOBILES.

One of the essential conditions for the speeding of automobiles at night is the proper lighting of the road. Ordinary side lanterns are inadequate, and therefore headlights which throw bright rays in advance of the vehicle must be used. Acetylene is well adapted for obtaining a brilliant light. It is by no means uncommon to see carriages provided with two searchlights, placed at the right and at the left of the vehicle. Such lights should have a common generator.

We shall consider some of the types of French searchlights at present most used; of the generators little is to be said, for the lighting system is the same for all, viz., a burner with adjacent jets, placed in the focus of a reflector, and a more or less intricate system of simple or compound lenses.

The generator of the Blériot light (Fig. 1) may be regarded as a typical example of the generators usually employed. It requires the employment of a special chemical compound of carbide and glucose, which is called by its inventors, Messrs. Letang and Serpollet, "acetylithe." The compound has the great advantage over ordinary carbide of being less sensitive to moisture, and of not leaving any solid residuum.

In order to introduce it into the lantern without difficulty, the generator is made in the form of a cylinder which slips into the receptacle behind the reflector when the cover of the searchlight has been raised.

The generator is charged by unscrewing the cover, *B*. When this is lifted it draws with it the cylinder, *C*, which contains the basket that holds the carbide. The bottom of the basket is perforated and furnished with vertical partitions, *S*, which prevent the carbide from packing too solidly and facilitate the access of the water. The generator cylinder terminates on top in a gas conducting tube, *A*, into which is introduced a tin cartridge containing ordinary carbide between two plugs of wadding, and which serves as a purifier. The gas is obliged to pass through this tube before escaping by the cock, *R*, and in so doing it is purified. The water is poured into the cylinder, *E*, up to the proper level, after which generator cylinder is put in place and the cover screwed on. The lamp operates on the same principle as those that use the Gay-Lussac briquette, in which the gas pressure forces the water out of the bell as soon as sufficient gas is generated. It is only necessary, therefore, to shut the cock, *R*, in order to stop its generation, but it is recommended that the charge be used up within three days.

In the Ouvrard lamp (Fig. 2) ordinary carbide is used in the generator. The cover rests upon a rubber washer, *J*, which it compresses when the handle attached to it is turned down.

The crushed carbide is placed in *B* first, after which the water is introduced into *A* through the threaded stopper, *L*. Its flow into the carbide is stopped by a center plug, *C*, which may be opened gradually by means of the small hand-wheel, *H*. It attacks the carbide therefore from below. The purifier, *D*, is placed above the carbide and contains broken pumice stone. The outlet pipe for the gas passes from the center of the purifier. It is at this point that the clearing up through the top of the generator starts. Its lower extremity is fitted with a strainer, *O*, in order to prevent the entrance of solid matter. Another purifier of the same kind is placed just below the burner, which is also fitted with a strainer at its lower end. A rubber bulb, *K*, communicating with the gas outlet tube regulates the pressure, and a cock, *G*, serves to regulate the supply of gas. When the center plug, *C*, is closed the flow of water ceases, and the flame is extinguished as soon as the supply of gas in the tube and pressure bulb is exhausted.

The Jupiter (Fig. 3), constructed by Messrs. Desponts and Godêfroy, makes use of any carbide, and constitutes a part of the lantern. In order to charge it, the water reservoir, *C*, which is held in place above the cylinder, *K*, by thumb-screws, is removed. The basket contained in the cylinder, *K*, is half filled with carbide and replaced in its position on the spring, *J*. The tube, *A*, perforated with small holes and containing a cotton wick, passes through the center of the carbide basket, from top to bottom. The tube is closed at the bottom but open at its upper end, which connects with the water reservoir, but is hermetically closed by the needle-valve, *P*, against which the spring, *J*, presses it. The needle-valve can be raised or lowered by means of the button, *D*, which therefore serves to control the flow of water into the tube. The reservoir, *C*, is filled through a hole covered by the threaded cap, *E*, and is hermetically fastened to the generator by thumb-screws as shown in the right-hand illustration. As soon as the needle-valve plug is raised, the wick becomes saturated and acetylene gas commences to generate. To put out the light the needle-valve is closed and the flow of gas soon ceases. A metal tube extends from the generator to the burner and passes through the purifier, *B*. There are two interesting particulars with reference to the burner of this apparatus: the first is, that if it becomes broken and there is no duplicate on hand, or if the carbide becomes exhausted, the burner may be immediately replaced by a spring candle holder, such as is used in carriage lamps. This is a resource which allows a journey to be continued under the best conditions possible with an ordinary lantern, since it utilizes the lens system of

Fig. 1.—The Bleriot Searchlight.

Fig. 2.—The Ouvrard Searchlight.

Fig. 3.—The Jupiter Searchlight.

Fig. 4.—The Ducellier Searchlight.

ACETYLENE SEARCHLIGHTS FOR AUTOMOBILES.

the searchlight. Another interesting detail is that if the burner is changed, it may, after it has been put in place, be turned in such a way that the plane of the light will be parallel with the lens. For this purpose it is furnished with a holder analogous to that employed on a jointed gas fixture. Anyone who has set up a butterfly burner and discovered after having sealed it, that the slot was not set right, will appreciate the special importance of this point.

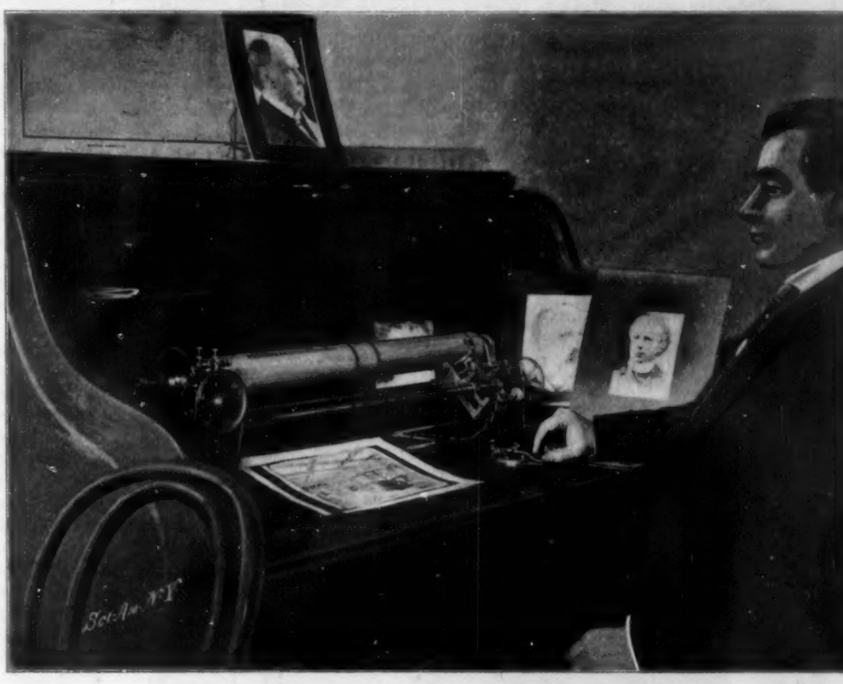
The Ducellier searchlight (Fig. 4) makes use of any carbide. The generator is integral with the lamp, and the carbide basket is the only part made removable, in order that it may be charged and cleansed.

The details of the lantern may be seen in the two diagrams on the left. The upper of these gives a general view of the system and the lower an outline of the different tubes. The carbide basket, *B*, has a vertical tube perforated with holes, passing through its center and arranged so that the attack on the carbide shall take place from below. A capillary tube, *E*, feeds the water drop by drop from the reservoir, *K*, whence it is conveyed by the tube, *A*, which ends in the chamber, *J*. The reservoir is filled with water through the hole, *M*, which is closed by a cap. After the operator has first closed the plug, *N*, and the cock, *R*, of the burner, the chamber, *J*, fills with air which cannot escape. The air closes the orifice of tube, *A*, and the water cannot flow upon the carbide.

It is only when the cock, *R*, is again opened that the air can escape by passing through the tube, *A*, and the tube, *Z*, which leads to the burner. The water may then pass through *A* and *E*, and the gas generated escapes through the same tube, *Z*, after having passed through the purifier made of horsehair and carbide. When, in order to extinguish the light, the cock, *R*, is closed, the gas passes through the bent tube, *V*, and the tube, *A*, and forces the water back into the chamber, *J*. As the water then ceases to trickle down on the carbide, the production of gas soon ceases. In case of over-production the gas passes from the chamber, *J*, through the water of the reservoir, *K*, and collects in its upper part whence its escape is provided for by the tube, *D*. A second generator composed of horse-hair and carbide is placed under the burner.

For small vehicles M. Ducellier manufactures the lanterns separate, and arranges them to be connected to a separate generator.

In thus summarily reviewing these different models of searchlights we do not pretend to have exhausted the subject, but have only wished to inform our readers as to the application of acetylene to automobile locomotion by taking as a type the systems which have been called to our attention, as being in actual use.—Translated for the SCIENTIFIC AMERICAN from La Nature.



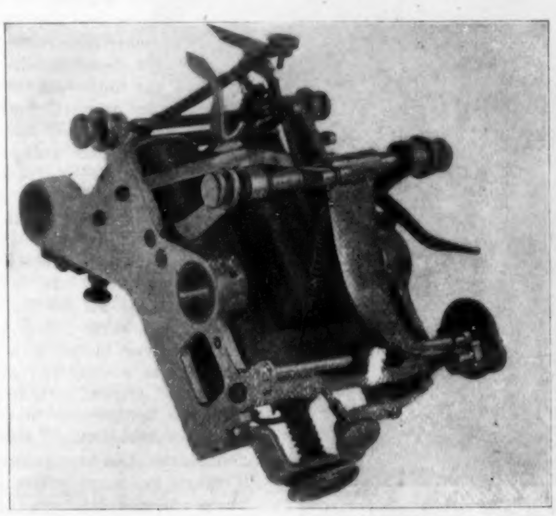
One of the Electrograph Machines, Showing Morse Key.

THE IMPROVED ELECTROGRAPH—A FAC-SIMILE TELEGRAPH.

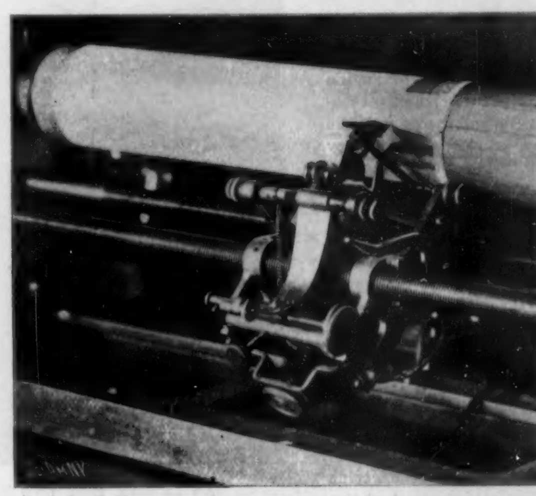
In the SCIENTIFIC AMERICAN for June 15, 1901, there appeared an illustrated description of an instrument which marked a decided advance in facsimile telegraphs. As it was there pointed out, this instrument, called by its inventors the electrograph, did not employ a chemically-printed paper or tissue to receive the pictorial message, but reproduced the picture transmitted, on ordinary paper with an ordinary pen. During the past year the inventors, Herbert R. Palmer and Thomas Mills, have so far improved and so greatly simplified their machine that another description may not be without interest. Through the courtesy of Mr. H. C. Bunting, the electrician in charge of the new machines, we are enabled to give an account of the improvements that have been made. While the new machine does not differ in principle from the old, the device has been changed in design with the result that difficulties met with have been overcome.

The principle of the electrograph's operation, as in all other electrical devices for the transmission of signals over great distances, is to be found in the making and breaking of an electrical circuit at predetermined intervals.

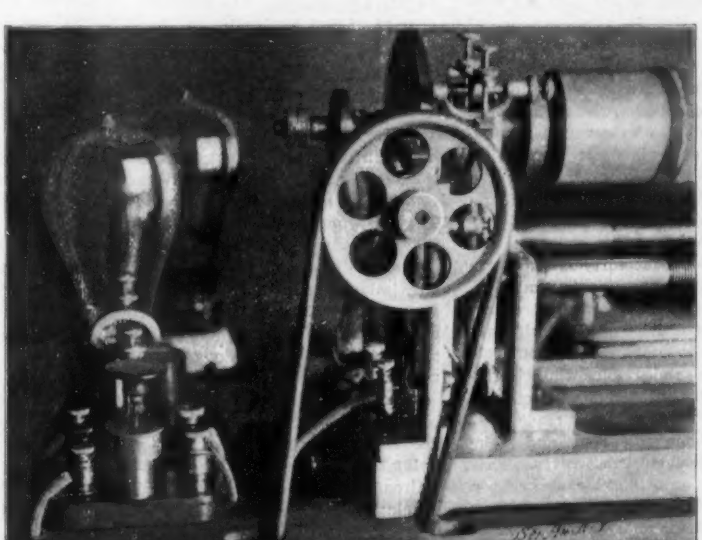
The transmitting and receiving machines are exactly similar in construction. The driving power is obtained from a 1-6 horse power electric motor supplied by a 20-volt storage battery and controlled by suitable switches and resistances. The motor is belted to a worm gear connected with a friction clutch, which ro-



The Carriage, with the Pen Thrown into Operative Position.



The Carriage, Lead-Screws, and Paper-Wrapped Receiving Cylinder.



Automatic Switch (to the Left); Driving-Gear; and Rocker-Arm Switch.

An Electrogram—Portrait of President McKinley. (Reduced.)

Cylinder Bearing McKinley's Portrait.

THE IMPROVED ELECTROGRAPH—A FACSIMILE TELEGRAPH.

tates a shaft carrying the synchronizing and regulating devices, and an aluminium cylinder 24 inches long by about 2 inches in diameter.

The motor also drives the gears operating the double-lead screws which control a carriage upon which are mounted a transmitting stylus, recording coils, and a pen. By using storage batteries for furnishing power to the motors, one of the most exasperating faults encountered in the old machines, the fault of speed variation, has been remedied. The motors of the old machines having been arranged for direct connection with the power or lighting circuit, a sudden drop of potential due to the falling on or off of a heavy load, as that of a motor driving a printing press or other heavy machinery, would cause a wide variation in the speed, thereby rendering it a matter of no little difficulty to regulate the machines. The storage batteries now used are connected with the lighting or power circuit in such a manner as to continue charging while the machines are in operation. It therefore follows that an approximately constant speed is maintained at all times. Still other improvements to be found in the new machine are longer cylinders, by means of which greater scope has been attained. Furthermore, the addition of an extra lead-screw has given the carriage greater stability and has increased the accuracy of the line-spacing mechanism. In general, the construction has been reduced to a model of simplicity, in which new features of adjustment have been combined.

In order to transmit a picture, a transmitting cylindrical sheet of zinc is employed, which is merely an enlargement of a half-tone plate of the picture. Since the variations in the surface of the zinc sheet cylinder are considerably more pronounced than those of the small original, the transmission of lights and shades is facilitated. The interstices of the zinc plate are filled with a non-conducting material, so that the entire surface is perfectly smooth. Thus treated a zinc sheet presents a fairly smooth, partially metallic and partially insulated surface.

The filled zinc plate is curled around the cylinder of the transmitting machine. Upon the surface of the zinc plate glides a stylus, which is caused to travel along the rotating cylinder by means of a carriage, very much as the reproducing stylus of the phonograph is caused to travel along the sound record. Thus the stylus comes into contact with every portion of the transmitting cylinder, describing a continuous spiral as the cylinder rotates and the carriage travels. Upon a piece of ordinary paper wrapped upon the cylinder of the receiving instrument plays an inked pen, which is caused to travel along the cylinder. Since the same instrument can be used either in transmitting or receiving messages, the carriage is provided with both a stylus and a pen so mounted that either can be thrown into or out of operative position. The stylus, as the cylinder rotates, glides over a surface partially metallic, partially insulated. When in contact with the metal a circuit through the line and receiving instrument is completed, and a line or dot is traced by the pen of the reproducing instrument, corresponding in length with that traced by the transmitting stylus. When the stylus is in contact with an insulated portion of the zinc sheet, the circuit is broken, and the pen of the receiving instrument is withdrawn from the paper. Thus an electrogram, a facsimile of the original picture is made.

The pen of the receiving machine is actuated by electromagnetic coils, by the making and breaking of the circuit, so as to reproduce the dots of the half-tone plates. These coils are operated up to a very high speed without perceptible lag. The pen is lifted from the paper with a speed equal to that of its closing impulse. The description of the magnetic coils previously published applies to those used in the present machines, for which reason it is unnecessary to go into details.

In order to synchronize the two rotating cylinders so that the picture may be exactly reproduced, resistance coils are employed which can be cut in and out of the field of the motor. It is clearly necessary to synchronize the two rotating cylinders, in order that the picture may be clearly reproduced. For this purpose a special synchronizing device has been invented, which operates a rocker-arm serving the purpose of alternately cutting in and out the regulating and recording relays at the proper portion of the revolution.

About one-eighth of each revolution is used for regulating purposes; in other words, during that portion of the revolution the rocker arm, operated by a cam on the main shaft, cuts out the picture circuit and throws the regulating relay into operation. Whatever gain one machine may make over the other during the revolution is corrected at this time, the fast machine being held until the slower machine reaches a corresponding position, whereupon both are started together again. Ordinarily both machines are set to stop at the end of every revolution. Just as they enter the regulating portion of the revolution, the line is opened for a short space of time at both the transmitting and receiving ends. The first machine finishing the revolution closes the line through its own regulating relay; but as the line is opened at the other end no action results until the machine at that end also reaches the end of the revolution. The line is then closed and both machines start simultaneously on the next revolution, by the releasing of the "control" magnets.

One of the characteristic features of the new machines is an auxiliary device for automatically changing from the ordinary Morse instrument to the electrograph and *vice versa*. At one side of the machine is a lever arm attached to an ordinary telegraph sounder, which arm is controlled through the combined action of its magnets. A spring and a liquid dashpot automatically switch the main line. When the picture mechanism is in operation, the lever arm is held down and the picture circuit cut in; if, however, the line is opened and held open for from five to ten seconds, the arm is slowly raised. When the arm reaches the upper position the electrograph is cut out and the Morse instrument switched into circuit. In operation the machines are connected with a telegraph wire in the same manner as the regular Morse instruments without any change whatever.

AN INDIAN MUD AND ROOT HOUSE IN ARIZONA.

The picture is sent at the rate of one inch per minute of the cylinder length; that is, a picture or cut which occupies the whole length of the cylinder, 24 inches, will be transmitted in 24 minutes' time. The speed of transmission, of course, varies with the fineness of the mesh in the original picture. It has been estimated that the space occupied by a cut in a newspaper could be filled by an equivalent number of words telegraphed by an ordinary operator at a speed of 25 or 30 words per minute. Hence, the time required in transmitting a picture by means of the electrograph is exactly the same as that consumed in telegraphing a verbal message. About forty minutes are required to prepare the zinc plate for transmission, and about thirty minutes to prepare the electrogram for newspaper printing. On a 1,500-mile circuit only eighty minutes are required to prepare a zinc enlargement, transmit the picture, and reduce the electrogram for the press. That this can be practically attained has been proven by severe tests made over the Western Union, American Telephone and Telegraph Company, and the Associated Press wires. That the machine has probably considerable newspaper value is demonstrated by the fact that Mr. Arthur Leslie has undertaken its commercial introduction.

SOME CURIOUS HOMES.

The Indian question is arousing some interest in California on account of the dispossessing of the Indians who have so long lived on what is known as Warner's Ranch, in San Diego County. These people have been here for generations, and failing to understand that the property belongs to the white man, have made a protest; but despite this they will have to move on, the government proposing to purchase a large tract for them, where, doubtless, they will be allowed to remain in possession for all time.

Contemplating the Indians of the Southwest, one is impressed with the fact that here are a people corresponding almost exactly to the people of the so-called stone age. This was essentially true of the coast and island natives. Within comparatively a few centuries they were provided with weapons and implements of stone, wood and shell, having no metals of any kind. In some camps of the Southwest Indians to-day almost a similar condition of affairs is seen; the people preferring to grind their grain in a stone *metate*, with a stone pestle—one of the commonest objects found in graves and kitchen middens; but in modern times the temptation is too strong, and the average Indian will buy a cheap basket from a store, or a mill, or a wooden pestle, and a set of tin dishes, than undertake the arduous process of making these articles.

Many of the Indians, so far as their habitations go, represent a very low type of civilization. This is well illustrated in the accompanying photograph, which shows the home of a Pima Indian, which in construction compares with the dens, nests, or abodes of many animals. The maker selected a tree with spreading root and overhanging branch. Against this he piled a few logs or limbs, packed the interstices with brush and filled the holes with a coating of mud. The door, as seen, was made by leaning a small limb against the tree and packing mud against it. On the top, as a roof, brush of various kinds was thrown. This is "home" to a Pima family which appears to thrive; a house which, while not as low in the scale as those of the native Australians, differs from them only in rank in being permanent. The beautiful structures of the orioles, the elaborate house of the gardener bird, with its lawn and freshly-plucked flowers, the neatly-made nest of some of the sticklebacks or the nests of some insects, as mere dwellings for a greater or less time, show that some animals are far ahead of some human beings in mere constructive ability.

All Pima dwellings are not of this class. Some of the huts resemble huge bee hives, and are made as were the early coast native huts of four hundred years ago. Eight or ten poles are thrust into the ground, ten or fifteen feet apart, and jointed at the top, over which fine branches are placed, points down, until the entire hut is covered with a mass of vertical twigs. Around it, at various heights, are bands of wood, made of limbs, holding the pseudo shingles in place. The base is banked up with earth to keep out the water, a small opening or entrance, three feet in height, being left on one side; and in lieu of a door a gunny sack. Among the Pimas, who number on the Pima agency of Arizona forty-two hundred, some attempt is being made to better their physical and moral condition. Among the Papagos at San Xavier, two hundred and ten are Catholics. Presbyterian missionaries are working among them and the Maricopas, but they have succeeded in obtaining a church membership of only one hundred and seventy-four out of about twenty-five hundred. The Catholics support the fine old mission of San Xavier del Bac near Tucson, and one at Santa Cruz. The women, many of them, are excellent basket makers, and this art is being encouraged as a means of making the tribe self-supporting.

The Yuma Indians are almost equally destitute of anything that savors of improvement. Father Englehardt, in referring to them and the Mojaves about the Needles, says: "They are in a most deplorable condition as to morals and progress toward civilization. They live under sheds made of sticks in summer, and in sweathouses or artificial caves in winter. When one of their number dies, all his property, as ponies, etc., is burned along with the body. In addition, relatives sacrifice large amounts of property, buying silks and clothing to add to the splendor of the funeral pyre. This custom along with drunkenness and gambling absorbs all the Indians' earnings."

It is an interesting fact that at the present time the best railroad laborers in the vicinity of the Needles are Indians, and despite their peculiar methods of living, they are highly regarded as laborers by the railroad authorities; in fact, they are about the only people who can endure the terrific summer heat of this region. All the Indians in this vicinity have for years, in fact for centuries, received the earnest attention of the missionaries of the Catholics, and schools of various kinds are maintained by different denominations, but doubtless little can be accomplished, especially among those who live near the border or railroad towns.

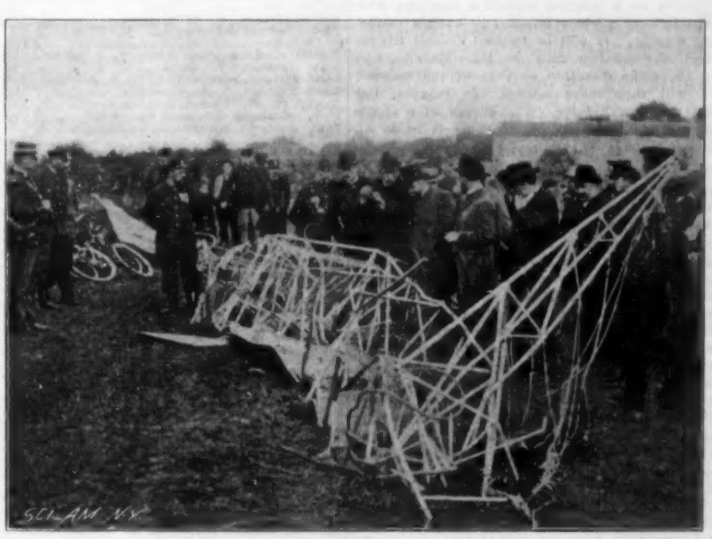
DE BRADSKY AIRSHIP DISASTER.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Baron de Bradsky, accompanied by M. Morin, made a trial of his airship on the 13th of October. When above the suburbs of Paris and at a height of 300 feet, the car became detached from the balloon and fell to the ground. The aeronauts were instantly killed and the car was, of course, wrecked. The start took place early in the morning from the Lachambre establishment in the southwestern part of the city. The aeronauts mounted the car, and while the assistants held the ropes, the balloon rose under the force of the ascensional screw. The propelling screw was then tried, and all seemed to work well. After bringing the airship to the ground, the aeronauts started for the final launch, and when at a certain height the signal was given and the balloon let go. It rose slowly at first, then rapidly. At 150 feet the propelling screw was put in movement and the airship seemed to be directed with ease. It was intended to take the balloon above the Issy maneuvering grounds to the south, but soon it was seen to take a northerly direction and come over the city. A strong wind was blowing in that direction, and no doubt the aeronauts could not make headway against it. They made a number of evolutions in large circles above the Champ-de-Mars and the Invalides. The wind proved too strong, and the airship was forced to take a northerly course over the city. It passed above the Opera, and was observed with great interest. Above the northern part of the city a rather heavy fog concealed it from view. At 9 o'clock in the morning the airship passed over a wide plain outside the city, and the aeronauts had succeeded in lowering it to 300 feet height and sailed along at that distance. They hailed one of the passers-by and inquired for a good landing place. Shortly after this, the airship was seen to take an inclined position, then the car became detached from the balloon, first in front, then in the rear, and fell with frightful rapidity. The balloon which was still swelled out, rose rapidly. The car, which was quite heavy, as it was built of steel tubes, fell violently on the ground, inclined at an angle of 45 degrees and sunk partly into the soil. The unfortunate aeronauts were found dead; like Severo, they fell in an upright position. The leg bones were terribly broken and mangled. M. de Bradsky had a large gash in the head, due to a fall.

It is to be remarked that this accident, so like that of Severo and his companion Saché, was due to an entirely different cause. In the former case the balloon caught fire from the motor and exploded, while in the latter the car became detached from the balloon. Steel piano-wires about 0.06 inch in diameter were used to attach the car, and these were fastened to a wood support running along the balloon and provided with eyelet holes. The wire was passed through the eyelets, then wrapped around itself, forming a loop. An examination which was made by experts seems to prove that the wires were not broken, but simply became unwrapped, due to the weight of the car. This took place first in front and the rest followed rapidly. According to several witnesses the airship took an inclined position, and this would be likely to produce such an effect. The main balloon was not provided with an interior airbag such as Santos-Dumont and Severo used to keep it swelled out in shape as it lost gas, and consequently was less likely to keep a straight position in the air.

Baron de Bradsky was a native of Saxony, 36 years of age, and had studied the question of dirigible balloons for five or six years, devoting his large fortune to this pursuit. Last year he had already built an airship, but on account of defective construction could not carry out his experiments until this year. M. Paul Morin, who was attached to the Lachambre establishment, was a distinguished engineer and aeronaut and one of the best known in Paris, having taken up this line of work as early as 1875.



THE WRECK OF DE BRADSKY'S AIRSHIP.

The First Transatlantic Wireless Message?

The daily press has published the news that Marconi has succeeded in transmitting wireless messages across the Atlantic from the station at Poldhu, Cornwall. Marconi himself has refused either to affirm or deny the report. Whether any credence is, therefore, to be given to the newspaper accounts is an open question. The New York Sun's correspondent, however, states that he has confirmed the report from other sources. It is said that the officers of the ship have given it out that the first message received was one of congratulation, and that on Monday, November 3, Marquis Solari, who came in from Table Head, received several messages from Poldhu on the "Carlo Alberto" as she lay in the harbor. Marconi has promised to give out a statement.

The Crawford-Voelker Incandescent Electric Lamp.

The inventor of the Crawford-Voelker lamp claims to have discovered a method of effecting a chemical union of several rare metals or earths with carbon, thereby obtaining for the first time a true carbide filament. The filaments made under the new process are said to possess a higher specific resistance than carbon filaments; seem to disintegrate much more slowly, and are practically uniform in their resistance. Lamps running to such high voltages as 500 have been successfully made and apparently do not possess the same delicacy as the 200-volt lamp of commerce. The Crawford-Voelker lamp at the start shows an economy of 39.8 per cent; after 500 hours of burning there is 50.4 per cent economy. At the end of 1,000 hours, 41.6 per cent economy is shown. These percentages are based upon tests made by Sir William H. Preece, with lamps of various manufacturers.

A Chance for Inventors.

The Johannesburg Chamber of Mines is desirous of taking steps to obviate or minimize the occurrence of miners' phthisis, and invites practical suggestions and plans for combating the causes leading to the same. No definite information is before the Chamber as to the causes of the disease, but the general assumption is that it is chiefly due to the inhalation of fine dust given off during the machine drilling operations. The Chamber offers the following awards for the three best practical suggestions and devices on this subject, viz., First prize, $2,500 and a gold medal; second prize, $1,250; third prize, $500.

In suggesting devices for attaining the object desired, the following points are to be specially taken into consideration: (1) The applicability of the device or the apparatus to the existing system of machine drilling; (2) the practical demonstration of the device or apparatus.

The judges, before making the final award of the prizes, will be entitled to require tests, and if they are not satisfied with any proposed device they will be at liberty to re-open the competition, or award a part only of the prizes. The papers in connection with this subject must be accompanied by the plans, models, or apparatus of the devices suggested, and will be receivable: A. At the offices of the Chamber of Mines, post-box 809, Johannesburg, up to the 15th of February, 1903. B. At the London agents of the Chamber, Messrs. Barsdorf & Co., Wool Exchange, Coleman Street, E. C., up to the 15th of January, 1903. C. At the Paris agents of the Chamber, the Compagnie Francaise des Mines d'Or et de l'Afrique du Sud, 20, Rue Taitbout, up to the 15th of January, 1903.

The judges for the award of the prizes will consist of two members of the Transvaal Medical Society, two members of the Mine Managers' Association of the Witwatersrand, and two members of the Mechanical Engineers' Association of the Witwatersrand, together with three consulting mining engineers to be selected by the Transvaal Chamber of Mines, and two practical rock drill miners to be selected by the Mine Managers' Association. The decision of the majority to be final.

RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

CONTROLLING DEVICE.—T. P. FORD, Hackensack, N. J. The object of this invention is to provide an improved controlling device designed for automatically controlling elevator-tank pressures and the like by opening and closing the admission-valve of a steam pump or a series of pumps discharging into the same tank, either gradually or quickly, according to the work required by the pump.

STEAM-BOILER.—W. HOPKINS, Dubuque, Iowa. This patent relates to improvements in steam-boilers embodied in that type generally known as marine-boilers; but the improvements can also be used in many other kinds of boilers. In the perfection of this apparatus the aim of the inventor has been to combine water-circulating devices with a tubular boiler in such a manner as to attain rapid circulation of the water through practically all parts of the structure, an almost perfect combustion of the fuel and the resulting gaseous products of combustion, and rapid generation of steam.

RETAINING VALVE.—W. G. LAMB, Mexico City, Mexico. This invention relates to fluid-pressure brakes of the Westinghouse type, and more particularly to retaining valves. The object of the inventor is to provide a new and improved retaining-valve arranged to automatically hold the full pressure on the brakes while recharging the auxiliary reservoir and to insure a proper release of the brakes whenever the train-pipe is recharged, the valve being exceedingly sensitive in operation. The device is intended to be thoroughly serviceable on long steep grades.

ROTARY ENGINE.—M. W. WALLACE, Eveleth, Minn. Mr. Wallace is the inventor of an improved rotary engine which is simple and durable in construction and very effective in operation. The arrangement of the parts is such that the steam acts both on the central and outer sections of a wheel and works expansively thereon, so that the motive agent is utilized to the fullest advantage.

Heating, Ventilating and Plumbing.

HOT-AIR HEATER.—W. P. HARTFORD, Cassville, Wis. This invention relates to that class of hot-air heaters or furnaces more particularly adapted for burning wood and in which the draft means is especially arranged to provide for automatically maintaining a substantially uniform draft through the combustion chamber irrespective of varying drafts in the chimney. The invention specifically provides important improvements on a furnace previously invented by Mr. Hartford.

SINK AND CONNECTION THEREFOR.—E. A. FOUNTAIN and S. MYERS, Oxnard, Cal. These inventors aim to provide a simple connection which can be made with readiness from above, and which will be easy of access when cleaning is necessary. The construction is simple, durable and economic and the connection is thoroughly water-tight.

Mechanical Devices.

TABULATOR.—F. RABINNOVITZ, Fort Totten, N. D. The tabulator is an improved device to be attached to type-writing machines, linotype machines, and others similarly operated, for convenience in tabulating. The object is to provide a device of this character that shall be simple in construction, having no parts liable to get out of order, and that may be quickly operated to indicate the proper places at which to stop the machine-carriage when writing figures or other tabulated matter, or to point out particular places wanted for operation or omission in the work.

CARTRIDGE AND SHELL LOADER.—P. KLINGER, Mansfield, Ill. Mr. Klinger is the inventor of an improved machine which may be used for loading rifles and revolver cartridges and may also be adjusted for loading shotgun shells. The invention includes many important features by which the operations may be very readily and effectively accomplished.

GLASS-BLOWING MACHINE.—W. H. TERLINDE, Coudersport, Pa. This machine comprises a table having an orifice therein, a sectional mold mounted on the table over this orifice to temporarily close it, and means for operating the mold sections and ejector in unison. Means movable up through the orifice on the table are also provided for delivering the molten glass, and the blow devices employed are movable down to the mold which is fitted with suitable connecting devices.

Miscellaneous Inventions.

PROCESS FOR WELDING ALUMINIUM.—MARY W. EMME, New York, N. Y. The inventor has discovered that by heating two contacting ends of aluminium under suitable conditions approximately to or above the temperature of 600 degrees centigrade, welding can be effected. To carry out the process successfully the parts or ends to be united must be scrupulously cleansed before heating them to the welding point. The mass or piece thus welded together possesses throughout the same physical qualities as though the parts had never been separated.

FISH-TRAP.—P. M. BENSETH, Fairhaven, Wash. This fish-trap is adapted to be floated in the water and to be held by tugs or otherwise against the tidal currents so as to entrap the fish moving with the current. The invention is designed especially for salmon fishing, but will be found useful in other connections as well.

ARTIFICIAL DENTURE.—W. P. LACY, South Boston, Va. It is the object of this invention to provide an improvement in that class of artificial dentures which are supported in the mouth without the aid of a suction plate, usually employed for the purpose. The artificial teeth in the present invention are secured by attachment to natural tooth roots.

AWNING.—C. S. HAMILTON, Salem, Ore. Mr. Hamilton is the inventor of an improved awning which is simple and durable in construction and arranged to permit of conveniently and quickly extending the canvas or moving it into an inactive position by the operator simply turning a crank.

COOKING UTENSIL.—J. F. FERRY, Leadville, Colo. This invention relates to improvements in casings for holding cooking utensils, such as kettles, frying-pans and the like, the object being to provide a simple means for conducting the odors of the cooking food into the stove.

HOSE-SUPPORTER.—KORA M. JOHNSON, New York, N. Y. An improved hose-supporter is here provided which is plain and durable in construction, and so arranged as to readily engage and securely hold the hose material without danger of unduly straining or tearing it. In disengaging the supporter from the hose, the clamping member must be pushed upward in the guideways and out of the same into an

opening and then transversely out of the latter, which completely releases the hose material from both members.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Inquiry No. 3366.—For magnetic chucks for milling machines.

Inquiry No. 3367.—For makers of electric clock alarm bells for colleges and schools.

Inquiry No. 3368.—For makers of articles of hard compressed paper pulp.

Inquiry No. 3369.—For compressed air apparatus for cleaning carpets and rugs.

Inquiry No. 3370.—For a stationary wire fence machine.

Inquiry No. 3371.—For manufacturers of portable cottages.

Inquiry No. 3372.—For makers of tierces, hogsheads or barrels holding about 45 gallons.

Inquiry No. 3373.—For manufacturers of automatic egg boilers.

Inquiry No. 3374.—For machinery for pressing straw into blocks for fuel purposes.

Inquiry No. 3375.—For manufacturers of wood-sawing machinery.

Inquiry No. 3376.—For makers of brass tubes.

Inquiry No. 3377.—For manufacturers of smoke consumers or fuel economizers.

Inquiry No. 3378.—For makers of rope-transmission apparatus.

Inquiry No. 3379.—For manufacturers of copper and iron tanks.

Inquiry No. 3380.—For a machine for engraving name plates on caskets, etc.

Inquiry No. 3381.—For manufacturers of family sewing machines as sold in department stores.

Inquiry No. 3382.—For manufacturers of "Zylonits."

Inquiry No. 3383.—For manufacturers of wooden napkin rings in large quantities.

Inquiry No. 3384.—For manufacturers of photographic mounts of different sizes.

Inquiry No. 3385.—For parties to manufacture a flat, endless coil spring.

Inquiry No. 3386.—For parties to make bicycle rims and tires to order.

Inquiry No. 3387.—For second-hand brick machinery.

Inquiry No. 3388.—For importers of Alvar steel.

Inquiry No. 3389.—For makers of carbide used for water gas.

Inquiry No. 3390.—For dealers in second-hand engines.

Inquiry No. 3391.—For seamless knitting machinery with a ribbing attachment for making ribbed hose with plain foot bottom.

Inquiry No. 3392.—For makers of steam sawmill machinery.

Inquiry No. 3393.—For makers of electric novelties.

Inquiry No. 3394.—For makers of electric motors from 1 to 4 horse power.

Inquiry No. 3395.—For an apparatus for holding disinfectants.

Inquiry No. 3396.—For dealers in printing frames for photographs.

Inquiry No. 3397.—For makers of nail nippers, clippers, files, etc.

Inquiry No. 3398.—For loud-speaking telephones.

Inquiry No. 3399.—For a compressed air tank of ½ lb. pressure to run a 2 h. p. machine.

Inquiry No. 3400.—For machinery for making cords and tassels.

Inquiry No. 3401.—For manufacturers of engraving machinery for button making.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(8743) **G. L. S. asks:** Will you kindly tell me if I hold a strong horseshoe magnet near a copper wire, say within a half inch, and then pass a powerful current of electricity through the copper wire, will there be any attraction between the wire and the magnet? If I made the magnet stationary, and then hold the wire very close to it, and slack enough for it to readily reach the magnet when the current is sent through it, would they move toward each other, or would there be no change of position at all? If they do attract each other, how strong a magnet, also how strong a current, will be needed to pull this wire say a distance of an inch or a little less? A. If a coil of wire carrying a current of electricity is brought near a powerful magnet, one end of coil will be attracted toward the magnet and the other end will be repelled from it. This is because the coil is itself a magnet and behaves as a magnet does. A straight wire will be very slightly affected by even a powerful magnet. It will be twisted around till its field of force lies with the lines parallel and in the same direction as that of the magnet. It will then move toward the magnet, but not with much force. The energy of a single wire is not great enough to cause it to do so.

(8744) **G. O. V. asks:** Will you please let me know what century or year, and where, the Romans first made the day to begin at 12 o'clock and end the next night at 12 o'clock? A minister told me some time ago that he guessed they did it in the fourth century. I want to know sure. A. We think you have been incorrectly advised as to the practice of the Romans in beginning the day at midnight. They did not begin to do this in the fourth century, since they seem always to have begun the day at the middle of the night. Varro, a learned Roman of the time of Cicero, wrote a book which has not come down to us, but which has been quoted by several authors whose works we have. The title of the book was "Concerning Human Affairs." One of the chapters was upon "Days." This chapter is quoted in the "Saturnalia" of Macrobius, Book I., Chap. 3, as also by Gellius in his "Attic Nights": "Men who are born in the 24 hours from midnight to the next midnight are said to have been born upon the same day." By which words it is evident, Macrobius says, "that they divided the observation of the day so that he who was born after sunset and before midnight, that should be his birthday in which that night began; on the contrary, he who was born in the six later hours of the night should be considered to be born on that day which followed that night." And this, so far as the authorities go, was always the practice of the Romans. The Babylonians reckoned from sunrise to sunrise (Isodorus, "Orig." V. 30), while the Athenians and the Hebrews reckoned from sunset to sunset (Gellius, "Attic Nights," III., 2.) "The same Varro in the same book has written," says Gellius, "the Athenians observe differently, in that they say that all the time intervening from one sunset to the succeeding sunset is one day."

(8745) **Y. M. C. asks:** Please give recipe for solution to oxidize nickel. A. To oxidize nickel, place the article for a short time in a dilute soluton of potassium sulphide, sodium sulphide, or ammonium sulphide.

(8746) **L. T. says:** We have a number of kerosene barrels filled with water on top of our buildings, to be used in case of fire, and during the winter are troubled considerably by the water freezing and bursting of barrels, although we put in one or two pails of salt as a preventive. We have been informed that people were in the habit of standing a piece of 2x4 pine on end in a barrel of rain water to prevent the bursting of the barrel. Would like to know the best preservative to use for preserving the barrels against the effect of exposure to the sun and elements. A. If the barrels are open in one end, there should be no bursting by freezing, as the expansion is not hindered. There would be no use in putting in a piece of pine wood. Salt is of use, but will not prevent freezing in extremely cold weather. Paint with asphalt to preserve the barrels against the effect of sun and rain; with good asphalt the life of such a barrel becomes almost indefinite.

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Dr. X. La Motte Sage, a Noted Scientist, Donates $10,000 to Be Used for the Publication and Free Distribution of a Valuable Work on Personal Magnetism and Hypnotic Influences.

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It explains numerous instances in which people have been secretly and instantaneously controlled by hypnotic influence. It tells you how to learn to protect yourself from the use of hypnotic power over you. It tells you how to learn to develop and use your magnetic power so as to wield a wonderful influence over those with whom you come in contact.

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It tells of a secret, instantaneous method by which you may produce a state of insensibility to pain in any part of the body, so that the teeth may be extracted and surgical operations performed without the use of cocaine, ether or anaesthetics of any kind.

It tells you how to learn to induce sleep in yourself or others at any time of the day or night that you may desire. It tells you of a subtle power by which you can develop your mental faculties, improve your memory, eradicate disagreeable tempers and habits in children, strengthen your will power and rise to a position of prominence in your community. It will truly make you a leader of men.

If you have not achieved the success to which your abilities and talents justly entitle you, if you would like to secure a good paying position, obtain an increase in salary, if you care to rise higher in your accepted business or calling, if you desire to wield a greater influence over others, if you care to win the love or friendship of some one you know, or if you long for fame or renown, you should write for a copy of this remarkable book at once.

The following extracts from a few of the letters received from some of the people who have read the book give an idea of its unusual character and great value:

Mr. T. L. Lindenstruth, 30 East South Street, Wilkesbarre, Pa., says: "Your work on personal magnetism is a fortune to anyone starting in life. It is absolutely sure to bring success."

A. J. McGinnis, 60 Ohio Street, Allegheny, Pa., says: "When I wrote for your book I was laboring by the day. Now I am managing a business. This is certainly the best proof that could be offered of its great value. I advise every man who wishes to succeed in life to get a copy at once."

G. S. Lincoln, M. D., 101 Crutchfield Street, Dallas, Texas, writes: "Your methods of personal influence are marvelous. I have used them on my patients with wonderful results."

S. R. King, M. D., Gilliam, Ind., writes: "You have truly sent me the most remarkable book I have ever read. Your instruction in personal magnetism is simply grand. It gives one a power and an influence over others which I did not dream it was possible for the average man to acquire. Your book is worth more than gold to anyone starting in life. Its value cannot be estimated. My only regret is that it was not in my hands when I was a young man."

The New York Institute of Science has undertaken the free distribution of the book referred to. Big roller presses are running day and night to supply the demand until the $10,000 worth of books are distributed free. On account of the great expense incurred in preparing and printing this book only those are requested to write for free copies who are especially interested and really and truly desire to achieve greater success, obtain more happiness or in some way better their condition in life. Please do not write through mere curiosity, as the free edition is limited. If you want a book write to-day, as the copies are going very fast. Never before in the history of the publishing business has there been such a great demand for any book as to-day exists for "The Philosophy of Personal Influence."

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Stove, hot air, D. Lamond.... 712,690
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"Anchor Bridges No. 6. Supplement," for building boxes, F. Ad. Richter & Co 9,524
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"Etiqueta Blanca Manteca Pura," for lard, Armour Packing Co 9,533
"Imperator No. 6," for building boxes, F. Ad. Richter & Co 9,519
"Imperator No. 8," for building boxes, F. Ad. Richter & Co 9,520
"Imperator No. 4," for building boxes, F. Ad. Richter & Co 9,521
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"Jewel Coffee," for coffee, Jewel Coffee Co 9,529
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PRINTS.

"Comet Brand," for syrup, American Lithographic Co 570
"Globe Brand," for syrup, American Lithographic Co 571

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